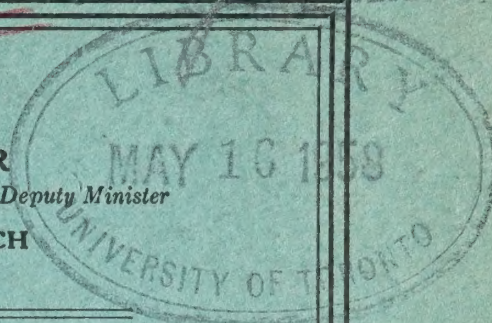


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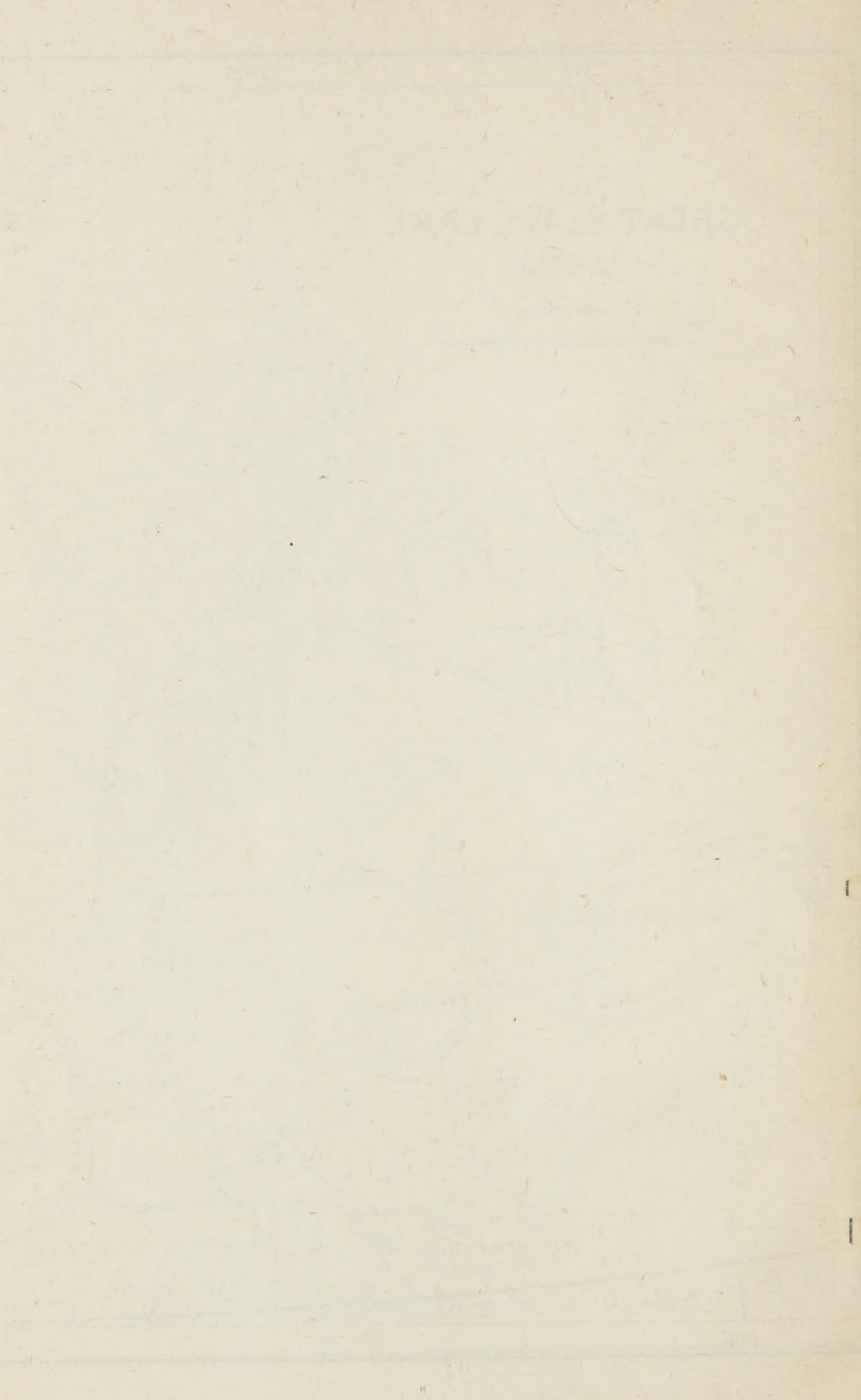
GREAT SLAVE LAKE AREA NORTHWEST TERRITORIES



F. A. ACLAND
Printer to the King's Most Excellent Majesty
Ottawa
1926

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COMPILED AND DRAWN BY THE TOPOGRAPHICAL SURVEY OF CANADA, OTTAWA, 1914



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GREAT SLAVE LAKE AREA NORTHWEST TERRITORIES

By G. H. BLANCHET, B.Sc., F.R.G.S., D.L.S.

TOPOGRAPHICAL SURVEY
DEPARTMENT OF THE INTERIOR



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THE GREAT SLAVE LAKE AREA

NORTHWEST TERRITORIES

INTRODUCTION

In the development of Western Canada the agricultural, ranching, and various industrial interests have expanded from the more accessible country outwards towards districts more difficult to reach and more costly in time and money to open up. It has become more and more apparent that the future of some of our basic industries lies in the country north of that now developed, and certain surveys have been made through the north country with a view to determining the nature and extent of its resources. From these surveys maps are prepared to assist development.

The surveys follow broad lines of exploration and leave the details of the intervening areas to be supplied by subsequent surveys as conditions warrant. By the extension of such control surveys in the area, in which Great Slave lake is the main feature, its topography has been revealed and a fund of useful information has been obtained on its resources and general character. The present report, for the most part, contains the information obtained on this work during the years it has been carried on, namely, from 1921 to 1925.

Location and Extent.—The territory included in this report under the title of Great Slave Lake area occupies a position between Hudson bay and the Rocky mountains, somewhat nearer the latter, and lies wholly north of latitude 60 degrees, the north boundary of the province of Alberta. Slave river from Fort Smith, Great Slave lake and Mackenzie river to Simpson extend north-westerly occupying the southwest portion of the area. From southwest to northeast the district includes the upper waters of Hay river, Great Slave lake, and extends far into the interior upland portion of the great Northern Plains.

While Great Slave lake is the most important topographical feature of the area, its other waterways are also important. The Mackenzie river with its tributaries ranks among the great river systems of the world. The uplands towards the northeast have the nature of a wide rolling plain and give rise to streams which drain into the great northern rivers; south and west of the Mackenzie, northwest to the Coppermine, northeast into Back river, and easterly to Thelon river.

The area comprises about 125,000 square miles, nearly half the size of the province of Alberta, or slightly larger than Great Britain and Ireland. The 60th parallel of latitude which forms the southern boundary is also the southern boundary of the Northwest Territories. This parallel passes through the Shetland islands, the southern part of the Scandinavian peninsula, central Russia, and southern Siberia. The extent of the territory and its location are in themselves sufficient to invite attention. It remains to be demonstrated what resources it has to offer and to what extent local conditions control their development.

Speaking generally, the more remote and inaccessible a district is, the more attractive must it be in economic resources, before development will take place. But it is unwise to consider any district or resource permanently beyond the limits of economic development because of its location. Developments in adjacent areas may give ready access to country formerly considered inacces-

sible; and economic values, governed largely by the laws of supply and demand, are in a state of constant flux. Scientific advances in industry, which lower costs of production, also increase demand, and in the case of "wasting" resources quickly bring under active development the natural wealth of outlying districts.

A locality which occupies a position at which diverging routes and interests unite, early assumes a position of importance. From this point of view Great Slave lake is favourably situated. Entrance to the Mackenzie valley is gained through the westerly portion of the lake while the eastern arm penetrates far into the Laurentian plateau towards the edge of the forest. Beyond to the north and east stretch the great treeless plains traversed by rivers draining to the Arctic ocean, Hudson bay, and Great Slave lake. The Mackenzie valley has industrial possibilities; the forest land yields fur and game; countless caribou range the treeless plains; and the Laurentian plateau offers prospects of finding minerals of economic value. The rivers and lakes are well stocked with fish.

From a continental standpoint, Canada can be regarded as divided, in regard to fauna and flora, into three main zones: the Canada zone which includes most of the settled country and areas to the north similar in character but rendered less desirable for settlement by poor drainage, the difficulty of clearing, etc.; the Hudsonian zone featured by a restricted flora and fauna; and the Arctic zone which takes in the great open plains beyond the forest line.

The Great Slave Lake area lies across portions of all three zones; the Canada zone portion includes Slave and Mackenzie valleys and the west end of Great Slave lake; the Hudsonian zone portion crosses the centre of the area in a broad belt extending northwesterly and separating the Canada zone to the south from the Arctic zone which embraces the northeastern uplands. Resources vary from the hay, timber, agricultural, and oil possibilities of the southwest to the fur, fish, rangelands, and minerals of the northeast. They are of sufficient value to invite investigation to-day and they offer a reserve for the future.

PLANT AND ANIMAL LIFE ZONES, GREAT SLAVE LAKE DISTRICT



CANADA ZONE OF MACKENZIE VALLEY

The Canada zone is featured by its comparatively luxuriant vegetation.



HUDSONIAN ZONE OF THE BORDERLAND OF THE LAURENTIAN PLATEAU

The Hudsonian zone is characterized by great irregularity of topography and numerous rock exposures.



ARCTIC ZONE—THE UPLANDS OF THE NORTHERN PLAINS

The Arctic zone is characterized by its gently undulating topography and comparatively deep soil cover. It is well covered with vegetation but supports no forest growth.

The name "barren lands" was originally applied to the northern treeless plains by Hearne in the narrative of his journey of 1770-71, as a translation of the Indian word "de-chin-u-le" meaning no trees; and through the use of this name in the narratives of those following him, it became established in describing that country. All recent observers who have travelled this part of the country agree in condemning the implication contained in the name; for a country with its hills generally covered with shrubs and with large grassy areas in its valleys cannot be called barren. It is proposed, therefore, to avoid the economic condemnation contained in this name, and to unite the treeless area under the broad descriptive name "northern plains."

History.—Early knowledge regarding the nature of the interior country was secured by the spectacular exploits of certain expeditions which struck boldly across the unknown country between 1770 and 1845. The motives of the earlier expeditions were primarily commercial. Samuel Hearne in 1770-71 crossed overland from Fort Prince of Wales on Hudson bay to the mouth of the Coppermine river. Hearne was connected with the Hudson's Bay Company and was anxious to obtain a direct knowledge of the country from whence the Indians brought their prolific supplies of furs. His interest was further quickened by the sight of implements fashioned from native copper. According to the Indians the metal existed in vast quantities along a river emptying into a sea which could be reached by ships. Hearne collected much valuable data on the resources climate, etc., of the country westward from Hudson bay to Great Slave lake. This expedition proved the existence of the Arctic ocean and resulted in the discovery of Great Slave lake itself.

The Northwest Fur Company was also working its way westward and northward from its bases in Eastern Canada, seeking to obtain fur at the source. Lines of exploration avoiding the difficult country to the west of Hudson bay were followed, by way of Saskatchewan river, to Churchill river and at the time of Hearne's journey a crossing had been made from the headwaters of the latter into waters draining northerly through an unknown country. Pushing explorations farther and farther into the north, Great Slave lake was reached in 1788, thereby joining Hearne's track. Alexander Mackenzie, one of the partners of the Northwest Company, by his two remarkable journeys, down Mackenzie river in 1789, and to the Pacific in 1792, may be said to have completed the work of defining the vast northern region between Hudson bay and the Pacific. The north Pacific coast was established, the existence of the Arctic had been proved, the northern Rockies were mapped, and a certain amount of information was collected as to the character of the country.

A period of scientific exploration then followed, which included the work of British naval officers who crossed the interior country to reach the Arctic in connection with the renewed search for a northwest passage through the northern ocean. These expeditions were equipped with instruments and included men of scientific training, and their records furnished much more accurate information about the country than the commercial explorations of the fur traders. The maps of the north country on which the principal features had been outlined were strengthened by greater accuracy of position and detail.

Two expeditions under the leadership of Franklin during the period 1819 to 1825 mapped Yellowknife river, a route to the Coppermine, and Coppermine river itself from where he reached it to the sea. He surveyed a portion of the coast and returned overland from the foot of Coronation gulf to his establishment at Fort Enterprise. His second journey included Great Bear lake and a large section of the Arctic coast westward of the Coppermine.

In 1833-34, Back made a long exploration northeasterly through the heart of the unknown country, passing through the eastern arm of Great Slave lake, the lake series to the north and east and down Back river to the sea. Explorations made by the Hudson's Bay Company, united with their Northwestern rivals since 1821, under Rae, Simpson, and Dease completed the delimitation of the continental coast line.

The dream of the Northwest Passage culminated and died with the ill-fated Franklin expedition of 1845. The passage was found to be in much higher latitudes than was at first supposed and proved to be entirely impracticable for commercial purposes.

The Arctic drainage portion of the country was now fairly well known, but eastward, between the height of land and Hudson bay, Hearne's map alone furnished the information on the country. A series of explorations carried on by J. B. and J. W. Tyrell, 1893-1900, established the main features of the great easterly drainage gathering into Chesterfield inlet by Kazan, Dubawnt, and Thelon rivers.

There has also been a certain amount of travel and exploration by private parties, scientific investigators, and police patrols which have added considerably to our knowledge of the country and its flora and fauna. Outstanding among these may be mentioned Warburton Pike's expedition of 1889 northward from Great Slave lake to the Coppermine; Hanbury's trips of 1899 up Thelon river, and his overland journey from Chesterfield inlet to Coronation gulf and thence to Great Bear lake; Bell's rediscovery of Father Petitot's route from Great Bear to Great Slave lake in 1908; trips to study natural history by Russell, Preble, and Seton; and the patrols of Inspectors Pelletier and French across the open plains.



RUINS OF FORT RELIANCE

Fort Reliance at the east end of Great Slave lake was Back's winter quarters 1833-34-35. The building in the picture, constructed around one of the old fire places, was built in 1897 by "Buffalo" Jones, a hunter and traveller who made his headquarters here when attempting to capture muskox calves for the Bronx Zoo in New York.

Gathering the information contained in the various reports and narratives describing travel and exploration and viewing it broadly, there is found in the earlier accounts, little consideration given to the country except in regard to its waterways as travel routes. Later, following the penetration and development of the great plains of western Canada, the resources of the North took on greater significance and the more recent investigators have considered its possibilities. However, it is difficult to get a clear picture of the country from the contradictory and somewhat confused accounts. The reader is seldom carried beyond an atmosphere of stress and hardship inseparably associated with travel in a new country but largely disconnected with the condition of the country itself. The traveller-explorers, less pressed by the necessity of reaching definite objectives, passed occasionally and in the informal language of their narratives they have described scenes entirely at variance with the generally accepted ideas of the country.

CHAPTER I

GEOLOGY AND TOPOGRAPHY OF THE GREAT SLAVE LAKE DISTRICT

What might be called the physical condition of the country is largely interwoven with its geological history. This has determined the original nature of the soil, its disposition and the topography. The past action of the forces of nature on the surface of the country and on the soil particles has produced the condition of to-day.

Geology.—Geologically the area includes the drift-covered sedimentary rocks of the west and the highly eroded Precambrian rocks of the east. The ice movement during glacial times stripped the soil and softer rocks and gouged and polished the harder formations; the loose material was transported, ground, and deposited irregularly on the retreat of the ice, and during the succeeding ages it has in part been assorted and enriched by water action and made more available as plant food.

The sedimentary—Precambrian contact in the area crosses Slave river below Fort Smith and in the lower valley of the river it is lost in the alluvial deposits, the Precambrian appearing along Taltson river and westerly along Great Slave lake as far as Stony island.

The Precambrian side of the contact crosses the lake by a number of small islands extending from Stony island to Gros cap. Proceeding up North arm the contact is usually covered by the waters of the lake. To the northward, Marian lake and the water route to Great Bear lake lie in the Precambrian area. On riviere la Martre there are high falls over limestone, otherwise the country is too little known to determine the location of the contact.

The Precambrian country.—To the northeast of the contact zone the country is marked by certain outstanding features, which are:—

(1) The great valley of Great Slave lake cuts deeply into the Laurentian plateau or Canadian Shield until it reaches a depth of 700 to 800 feet at the east end, plus the depth of the water of the lake. It holds a general northeasterly course and is continued in this direction by the valley of Lockhart river and Artillery lake. At the easterly end of this lake the valley is lost in the undulating drift plains of the height of land.

Ptarmigan lake also lies in a poorly defined valley in a country featured by glacial deposits, sand and boulder moraines.

(2) The bordering zone of the Precambrian plateau is a district of varying width which exhibits tremendous glacial erosion and is lightly covered with glacial deposits, largely boulders.

This includes the country bordering the valley of the east end of Great Slave lake, including Lockhart river and the southwest end of Artillery lake. Country of this nature is not seen again until near the south end of lake MacKay. From here it swings northerly and reaches Coppermine river west of lac de Gras. This country is chiefly composed of granite and gneiss with local areas of metamorphic rocks. In the shelter of its valleys, trees reach fair development and the northeastern boundary of this zone marks the limit of the forests.

(3) The interior uplands include the country from the border zone extending north and east to the 1,000 foot contour or 500 feet above Great Slave lake. It is almost entirely lacking in prominent hills and valleys; the topography is subdued. The surface is usually undulating to rolling, though some-

times locally rough. The drift soil is sometimes of considerable depth, and it is generally of finer materials than on the border zone. Sandy areas, dunes, and ridges are numerous. The uplands are crossed by wide, flat valleys in which the rock is of a schistose character. This is usually worn down to an undulating topography. The enclosing rims of the valleys are of granites and gneisses, usually in the form of low bare hills. The fracture plane of the schist is usually nearly vertical and apparently the schist varies considerably in hardness as the outcropping low rough ridges are separated by stretches of level country with good soil. In places it is chiefly a biotite schist, in others a greenstone, and again hard and massive.

Clinton-Colden lake, Aylmer lake, and lac de Gras occupy depressions in the metamorphic rocks.

Lake MacKay lies at right angles to the above valley. It occupies the top of a morainic plain stretching from the border zone country of its south end of the prominent granite and gneiss ridge forming the southwest boundary of Aylmer lake. It drains uncertainly through the irregularly deposited moraines by many rapids and one fall to Aylmer lake.

(4) The coastal plains extend from the interior uplands to the Arctic and Hudson bay. They were not included in the investigation.

Glacial action.—The moraines observed take the form of irregular deposits largely boulders and coarse gravel and often shaped like a bee hive, and lateral moraines holding very regular northwest and southeast courses. The latter often persist for many miles with few interruptions and are of very uniform height and cross-section. They vary from pure sand to almost entirely boulders. These lateral moraines often formed the shores of post glacial lakes having well-marked beaches.

On the interior uplands the ice retreated southeasterly, but the advancing ice moved along the line of the Great Slave lake valley southwesterly. The striae and especially the groovings are deeply marked.

Topography.—Viewed broadly from west to east, the high land of northern Alberta and the foothills of the Rockies subsides to the plain of Mackenzie valley and the west end of Great Slave lake, broken by Caribou and Horn mountain areas. Proceeding northeasterly, the underlying Laurentian rocks would be seen to rise from the plain and flatten into a tableland of moderate relief.

Dominating the area, Great Slave lake would be seen forming a deep indentation into the upland area of the east, stretching across the contact zone, and spreading onto the plains in the great open body of its west end, thence discharging westerly by Mackenzie river. Great Slave lake marks the 500-foot contour in the country.

Imagine the waters to rise 500 feet and mark the 1,000-foot contours. The sea would extend into the area from both the west and the east, and also far to the south up the Slave river valley. The land in Great Slave lake area would consist of a great promontory stretching northwesterly from the Laurentian plateau east of Slave river. There would be a narrow neck where Great Slave lake approached Thelon river. Its somewhat distended extremity would include the upland area forming the height of land of the rivers of the north. It would terminate on the west at the waters joining Great Slave and Great Bear lakes, and to the north by a line joining the upper waters of Coppermine river to those of Back river, swinging sharply southward toward Hanbury and upper Thelon rivers and finally eastward towards the upper waters of the Dubawnt river. Across the southwest the Alberta plateau escarpment would mark the shore line. Horn mountain plateau would stand out as an island. It would be noted that the land not covered by this hypothetical sea all exhibited a condition of low relief. It would have few elevations higher than a few hundred feet and would be entirely lacking in deep valleys. The rivers of the district and their tributaries would be found to be rising in the exposed highlands and radiating from them.

Should the waters rise another 500 feet the land would be reduced to a few small islands.

It is probable that following the glacial period the water covered the country to about the 1,000-foot contour. During the slow subsidence, fine materials were carried down from the highlands by the rivers, and successive beaches were formed marking temporary periods of pause. Ultimately the condition of to-day was reached which may be taken as a fairly stable one, as Mackenzie river has cut its channel pretty well down to grade.

The portions of the district lying between 500 and 1,000 feet in elevation may be considered as old lake-bottom land; the materials forming its soil have received a varying amount of assortment and there has been enrichment by subsequent deposits. In the case of the highlands, the same process on a small scale took place. The present lakes are the remains of much larger ones and the soils of the low lands bordering them exhibits a certain amount of assortment and enrichment. Viewed from this angle the conditions of soil and topography obtaining in the district become clear. The varied nature of the soil is the natural result of glacial deposits and the enrichment of the lower lands, both on the plains and in the highlands, is the result of the processes to which they have since been subjected.

CHAPTER II

CONTROL SURVEYS IN THE AREA

Generally speaking a survey in a new or little known country is for the purpose of ascertaining what resources it has to offer and the general conditions affecting life in the country; and, to assist its development by making this information available in maps and reports. A first essential for any intelligent investigation or development is a good map. It must be possible to fix locations and to have a good idea of the relative positions of different points, with the natural means of communication between them. This is especially important in the North where practically all travel is by water.

Given the map, the next important consideration is how the district may be reached, the conditions of travel through it, the general factors affecting life in the country; and, lastly but of great importance, the record of the survey should suggest what resources the district may possess to warrant further investigation and possible development.

Another aspect of the question is that, in dealing with natural resources, consideration should be given to resources which may not be profitably developed to-day but which may have value in the future. To protect industry the amount of raw material must be known, its sources guarded, and principles of conservation applied.

Attention was directed to the lower Mackenzie valley by the discovery of oil near Norman. This resulted in the filing of a great number of oil claims. Surveys were urgently required to locate these claims, to provide a foundation for "tying in" future oil and mineral claims, settlement lots, etc., to chart navigable waters and generally to extend the geographical knowledge of the country. A modified stadia traverse method, known as the control survey, was adopted. By this method the shore lines of the travelled waterways and of the islands are accurately surveyed and at suitable intervals permanent monuments are erected. The geographic position of each of these monuments, based on the primary control furnished by latitude and longitude observations at points roughly seventy-five miles apart is accurately calculated from the traverse. Advantage was taken of the newly developed portable wireless telegraph receiving equipment for accurate determination of longitude.

Operations along the Southern Shore of Great Slave Lake and Mackenzie River during 1921.—The short season of northern navigation saw intense activity in the field of operations. The parties engaged on this work moved north on the edge of the retreating ice carrying the survey from the last point of the Dominion land survey system (the crossing of the Slave river by the 30th base line) down Slave river to Great Slave lake, through the western portion of it to Mackenzie river and down Mackenzie river past the oil fields.

The operations of this season demonstrated the practicability of the methods adopted as an economical and efficient means of surveying the north country.

The surveys of these waterways, together with surveys and investigations by the Geological Survey of Canada along tributary streams, embrace the southwestern portion of the area where conditions characteristic of northern Alberta persist. It might be described as the country of the Mackenzie valley, using the term "valley" in its broadest sense. The main sources of its waters are in the mountains but certain smaller streams rise on the Alberta plateau.

This country, underlain by sedimentary rocks, rises towards the south to the hills and escarpments which form the northern limit of the Alberta plateau and to the north it stretches in a plain of low relief, broken only by the elevated area known as Horn mountains. The soil is largely boulder clay similar to that of the southern plains. (Well developed forests exist where conditions are favourable.) The lakes of the area, among which is included the western portion of Great Slave lake, are regular in outline and generally not deep, with low shores rising gradually from the shallow marginal waters. The rivers from the south drop abruptly from the upper plateau level and are usually marked by gorges and falls where they leave the escarpment.

In addition to the survey of the waterways, which was the main object of the work of this season, many other useful purposes were served. The navigation situation was studied and the best routes were shown on maps prepared from the survey and used later as navigation charts. Investigations made at those points at which navigation was hazardous showed the necessity for assistance in the way of buoys and beacons. Temporary marks were set and during the following winter the matter was taken up with the proper authorities which resulted in this work being continued as part of the regular program of the Lighthouse Board.



THE MACKENZIE BEACON AID TO NAVIGATION

Low flat shores, shoal waters and a confusing mass of islands made entrance to the Mackenzie river difficult before this beacon was erected by the Topographical Survey in 1923.

In short, the survey revealed the general character of the country, its resources, and its limitations, and by making this information available will assist economic development.

In order to make maps available with the least possible delay, the practice has been followed, of issuing the maps of the work of one season the following spring. A scale of one inch to four miles was adopted for maps used for navigation and one inch to six miles for those of general use. These maps furnished the base for geological investigations made during this and subsequent years in the Mackenzie valley.

Operations in 1922—the Survey of the East End of Great Slave lake.—This season the eastern portion of Great Slave lake was surveyed. Previous maps showed this end of the lake as determined by Back in his rapidly executed track survey. It was impossible for him to do more than suggest a shape and fix a limit. Where islands are numerous there is little resemblance between Back's map and the actual lake, but in the more open portions, such as McLeod bay, the track survey was fairly accurate. It is interesting to compare the lake as it appeared to a trained observer and geographer in a hurried trip through it, with that revealed by a complete survey.

The country contiguous to the portion of the lake surveyed in 1922 is essentially different from that of the Mackenzie Valley district. It forms part of the Laurentian plateau with its characteristic thin cover of soil and heavily glaciated rocks. The fauna and flora determined by its soil and climate are common to a belt of country stretching across Canada (the Huronian belt) and perhaps best known in the district north of lake Superior.

The Laurentian plateau at Great Slave lake emerges from under the sedimentary rocks to the west, increasing in elevation northeasterly till at about seven hundred feet above the lake it reaches what may be considered the country level. As is usual, the line of contact between the two formations is a line of weakness and is here represented by the North arm and by Slave river valley. A great number of islands which mask the bordering main land and the larger islands emphasize the irregular local topography. The valley of the east end of the lake is trough-like, the shores being escarpments of the edge of the plateau.

After passing through the massed islands which nearly fill the lake for a distance of 60 miles, the main body of the east end of the lake is entered. It is divided longitudinally into Christie and McLeod bays by a long narrow peninsula which nearly joins the north shore at the narrows of Taltheilei. The peninsula has a peculiar geological composition and structure which have given it a vertical northern face and a steep pitch to the south. A remarkable effect is produced by the long lines of vari-coloured walls rising upwards of 800 feet, in places with a single face, at others terraced, and again in blocks and columns. Repetitions of the structure in successive ridges give a sawtooth appearance to the country when viewed from certain angles. Some 3,000 miles of shore line were included in the season's operations, which completed the survey of the eastern arm and its islands.

Operations at the North Arm and exploration to the Northeast during 1923.—The survey of the complicated waters of the northeasterly side of the North arm was made, and an exploration was carried from the east end of Great Slave lake through a portion of the waterways travelled by Sir George Back in 1833-34. In addition to mapping the North arm, a further study was made of conditions existing at the edge of the Laurentian plateau; and a country favourable for the occurrence of minerals was opened up for investigation.

From North arm a number of water routes lead off into the interior country. Franklin's route to the Coppermine leaves by Yellowknife river. The Indians have a much travelled portage route to the same river leaving from Russell lake at the extreme northeast of the arm, by which formerly they reached the

country of the musk-ox. From the north end of Marian lake by a northwesterly water route, Great Bear lake may be reached. This is to be used by the winter patrol of the Royal Canadian Mounted Police from Resolution to Coronation gulf. There are also several waterways by which the Indians enter the little known country to the northwest generalized under the name of the lac la Martre country.

Rae settlement, the outpost of civilization in this direction, was surveyed. Considerable work was done in connection with aids to navigation, beacons were constructed, lights set up, and buoys placed.

The exploration extended into country beyond the forests formerly generally spoken of as the "Barren Lands." This completed the cross-section of the Hudsonian zone and entered that with fauna and flora characterized as Arctic. The conditions which would have to be met in carrying on surveys in this country were studied; information was gathered as to the necessity for surveys, the best routes to follow, and the methods to be adopted.

Operations in 1924—survey over ice and of the northeastern uplands—further exploration.—In the early spring of 1924, a small party was sent to make a transit and chain survey on the ice, in order to establish the positions of certain key points on Great Slave lake and to survey outer islands difficult to reach in summer. The survey of the North arm was also completed and the traverse of



SURVEY PARTY ON GREAT SLAVE LAKE

With canoes loaded on the sleds the survey party attempted the 60-mile crossing of Great Slave lake on May 26, 1924. Wide leads of open water and bad ice forced a return from a point 13 miles out. Next morning the ice had broken and was in motion.

the north shore was carried westward towards Mackenzie river to join up with the work of 1921. Interesting data as to weather, and snow and ice conditions prevailing at this period of the year were gathered.

The chainage across the open body of the lakes was successfully accomplished. Pressure cracks which often cause much trouble in large lakes, presented little difficulty on this work.

The spring thaws first produced slush on the ice in day time which froze at night. This was followed after the water had run off into the cracks by perfect ice—nearly glare—but a renewal of warm winds continued the "rotting" first by pitting the surface, then as the small holes deepened and enlarged, a surface of sharp points was formed and finally the ice became "candled" and the breakup followed.

The survey was continued through the various stages of the thaw till May 24, when it appeared advisable to make the crossing to the south shore to avoid being caught by the disruption of the ice. The party, with two canoes set on runners and hauled by dogs, left Hardisty island at the western junction of North arm and the main lake early on May 26 and headed for Resolution. The ice, which was good in the early morning, softened rapidly when the sun rose.

At a point some thirteen miles out an extensive, wide lead blocked further progress and made a return advisable. Hardisty island was safely reached. Next morning the ice was in motion and the disruption followed rapidly. This was an exceptionally early date for the breakup but was explained by the fact that the fall had been very open and that there had been periods of mild weather during the winter.*

After the ice cleared the traverse was continued by canoe till the arrival of the survey schooner with the remainder of the party for the summer work. All were then moved to the east end of the lake and the survey of the lakes to the north and east was begun. This work was carried on chiefly in the plains beyond the trees. Gasoline was carried for fuel and small gasoline stoves were used for cooking. Laths had to be brought in for survey pickets. In addition to the survey of the lakes, an exploratory survey was carried out to the northwest by which a canoe route was found to lac de Gras and Coppermine river; and in crossing a wide stretch of the upland area much information on the northern plains was obtained. The survey was carried through the lakes from Great Slave lake to lake MacKay and spurs extended some distance down Hanbury and Back rivers. Lac de Gras and lake MacKay were defined by track surveys and observations.

In 1925—Survey of Hay river, Marian River route northward from North Arm, and exploration southeast of Great Slave lake.—The season of 1925 saw a further broadening of the survey of the district. On the south, Hay river was surveyed from its crossing of the 6th meridian to Great Slave lake. Upper Hay river is reached by descending Peace river to Fort Vermilion and travelling overland by wagon to Hay River post, some 30 miles down stream from the 6th meridian crossing. The survey of this river included the location of the point where the north boundary of Alberta crosses the river; and an examination of the great falls, Alexandra and Louise, where the river drops from the Alberta plateau.

The party then completed the survey of Great Slave lake by surveying the 20 mile gap of the north shore between the work of 1921 and that of 1924.

The completion of the survey of this great lake, with its thousands of miles of intricate shore lines and its islands, which also number thousands, is an event of importance in the history of northern surveys. On this work new methods and new instruments have been introduced and have proved satisfactory. The map of the lake has been changed from little better than an explorer's sketch to one of complete and accurate detail, on which navigation routes are marked, locations of harbours indicated, and the character of the interior country generally determined.

The party then proceeded up North arm; and, after surveying a few more settlement lots in the vicinity of Rae, began the survey of the waterways extending from Marian lake to Great Bear lake. The survey was carried to the head of Marian river draining to Great Slave lake, and thence across a short divide to a series of large lakes draining through Camsell river to Great Bear lake. This survey was carried as far as the north end of Hardisty lake.

This great stretch of country, which covers an area of some fifty thousand square miles, lies between Great Slave lake and Athabaska lake and extends eastward from Slave river to Dubawnt river. Knowledge of the interior was previously limited to that contained in Hearne's narrative of 1772; a suggested route across the country by Dr. King, Back's assistant in 1835; and the explorations of Charles Camsell of the Geological Survey along Tazin and Taltson rivers in 1914.

It was considered that the most effective work would be accomplished by holding a northeast direction at right angles to the Taltson-Tazin route.

The Indians at Fitzgerald strongly recommended Taltson river as a route to the interior country, though they were unable to say whether or not Thelon river could be reached from it.

*For a description of ice condition in Great Slave lake, see Chap. V, page 42.

Taltson river was reached from Fitzgerald by a well known Indian canoe route by way of Dag and Hanging-ice rivers. There were three recognized Indian routes eastward; the first by way of a small stream entering Hill Island lake, supposed to be on the line of Hearne's route; second by Thekulthili lake; and third up Taltson river from its junction with Tazin river entering from the south.

The exploration was made up Taltson river. On reaching the summit of the plateau the river widens into long narrow lakes which hold a very regular course north-northeast for over one hundred and twenty-five miles. A branch swings easterly from a point 75 miles up the lake series and takes its rise at the edge of the open plains over one hundred miles east from this point.

From the latter branch by an exploration northerly an ancient Indian portage route, forgotten even by the Indians, was discovered to the headwaters of the west branch of Thelon river, and this river was followed northerly for a distance



ON HEADWATERS OF THELON RIVER

This river rises in the open plains, but a straggling growth of timber persists along its valley. Its waters abound in excellent fish especially trout up to thirty pounds in weight. The light folding canvas boat proved to be an excellent conveyance for an exploratory trip.

of fifty miles, through a series of large irregular lakes joined by rapids. To reach Thelon river from the Taltson basin it was necessary to cross the Hudson bay divide which here marks approximately the line of the edge of the forests.

Returning from Thelon river, a portage was found from the most northerly point on Taltson river to Snowdrift river which enters Christie bay of Great Slave lake. Snowdrift river was followed to the lake. This part of the journey included a descent of over 500 feet, which occurred in a distance of about twelve miles, where the river becomes a series of rapids, cascades, and falls.

This completes the operations in the district to date, and it may be seen that there is no great area which remains entirely unexplored. Detailed information including navigation routes, location of falls and rapids, and length of portages has been shown on the maps compiled from the surveys. The character of the inland areas has been outlined by the descriptive notes. The permanent monuments of the control survey form a framework from which surveys may be extended to any district on which interest is centred or from which the work of filling in detail of the intervening areas may be proceeded with.

CHAPTER III

GENERAL DESCRIPTION OF THE AREA

For convenience in describing the country the area has been considered as divided into a number of sub-areas in which certain characteristic conditions prevail or which are dominated by principal features.

These will be considered in the order in which they would be seen in traversing the country.

The Southern or Slave River Valley portion.—At Fort Smith, Slave river crosses a spur of the Laurentian country to the east in a series of heavy rapids. From there to Great Slave lake it flows through an alluvial valley which originally formed the south arm of the lake. The settlement of Fort Smith has considerable local importance, owing to its situation at the head of navigation of the lower river. Here are located the Government administrative offices, and the Royal Canadian Mounted Police headquarters for the northern district. The Wood Buffalo park, where range the last remaining herds of wild buffalo lies west and south of Fort Smith. Farming operations have been carried on for many years by the Roman Catholic mission on Salt river, some thirty miles west. The scene here at harvest time suggests some outlying Ontario valley rather than 60° north latitude.

Slave river has a valley over one hundred feet deep at Fort Smith, but proceeding downstream the high land recedes from the river which flows through a low and remarkably level plain. The excellent alluvial soil of its banks produces spruce that compare in size and quality with that of any other locality in the west, and the underbrush is varied and abundant. Through this plain the river flows with alternate long straight stretches and great meanders. Due to the depth of the river (in places exceeding eighty feet), the soft character of its alluvial banks and the strong current, the erosive action is tremendous, resulting in a great loss of land and of timber growing along the banks. No streams of importance enter lower Slave river. This is readily explained by the fact that its course is closely paralleled by Taltson river on the east and Little Buffalo river on the west.

Slave river on entering Great Slave lake deposits its load of silt and a great and constantly growing delta has been built up, through which the river discharges by many channels.

The delta has a width of over twelve miles between the extreme north and south channels. At one time, however, it extended much farther northeast, reaching to the rocky country at the mouth of Taltson river, which is similar to that exposed at the Fort Smith rapids. A view of the delta from above would show a series of bands lying at right angles to the course of the river, with the gradation from old to new land clearly marked by the successive growths of timber, which vary from spruce and white poplar to small black poplar, and from high alder to small alder and low willow, and finally to extensive mud flats covered with drift logs. Beyond, the shoal waters, covering the delta of tomorrow, stretch far out into the lake. The great quantities of drift logs carried down by the river play an important part in building up the new land. When stranded, they give stability to the rapidly accumulating silt. From time to time log jams form across the mouths of the smaller channels which then soon block up with silt. In the 150 years during which it has been under observation there have been considerable changes both in the extent of the delta and in its

channels. Navigation in the delta is difficult but has been considerably assisted by the survey of its channels and the investigation charting and buoying of the bordering waters.

A trading post has been maintained in the vicinity of the Slave river delta since the arrival of the fur traders in 1788. The location was often changed in the early days, being moved from Grant point near its northern extremity to the vicinity of Resolution at the south. The present locality of Resolution was selected by the Roman Catholic mission and their substantial buildings have given it a permanent character. It has an unfortunate situation from a navigation point of view, being on an open, shallow, sandy bay; but on the other hand the soil is good and the mission farm has been successfully operated for some years.

From Resolution three important routes into the north diverge; Westward lies the way to the Arctic by Mackenzie river; northward, through the North arm of the lake, access is gained to a great stretch of country important in the fur trade and as a prospective in its mineral prospects produced; and eastward lies a route to the great northern plains.



ALEXANDRA FALLS, HAY RIVER.

The river drops abruptly from the Alberta plateau in the Alexandra and Louise falls of 109 and 50 feet respectively. The situation here closely resembles that at Niagara in character of the falls and canyon.

The Western or Mackenzie Valley portion from Resolution to Simpson.—To reach Mackenzie river from Slave river, the open body of the west end of the lake is crossed, keeping close to the south shore. This shore is generally low, the water is shallow, and there are no islands, except those in the vicinity of Resolution and a few small islands close to the shore.

To the south, the dominating topographical feature, the plateau known as the Caribou mountains, is too far distant to be visible from the lake. It is an area underlain by sedimentary rocks less eroded than those of the surrounding country and heavily covered with glacial drift. The country lying to the northward of the plateau is little known. It has been described as a gently rolling, well wooded plain, dotted with numerous small lakes. Three large rivers carry the northerly drainage from the hills, Little Buffalo which passes around its eastern border, Buffalo river rising in some large lakes lying off the northerly escarpment, and Hay river which takes its rise near the foot hills of the Rocky mountains, and passes through the broken western edge of the plateau. The

plateau is known as the Caribou mountains between Little Buffalo and Hay rivers but to the westward it is known as Cameron hills and finally merges into the escarpment forming the southern boundary of Mackenzie valley.

The country traversed by Hay river was found to exhibit the general character of lower Peace river. Its soil varies from boulder clay to sand; its vegetation includes good forests, abundant shrubbery, and excellent haylands. The river drops abruptly from the plateau in two falls, Alexandra and Louise, with a total drop of 150 feet. The situation here bears a striking resemblance to that at Niagara falls both in the rock formation and the manner in which the gorge has been cut out by erosion. The excellent soil of the delta land at Great Slave lake produces good forests, and the fertility is attested by the excellent mission gardens at Hay river.

On the north side of the lake, west of North arm, the country is a low, broad plain dotted with many lakes and muskegs. It contains no rivers of importance and is mostly rather thinly wooded, with large prairies occurring in some localities.

Farther west, after descending Mackenzie river some fifty miles, an elevation, known as Horn mountains, may be observed to the north, standing out prominently from the plain. These hills were reached at two different points by the late Mr. E. J. Whittaker of the Geological Survey of Canada. His first trip was made by way of Horn river which reaches and passes around the easterly end of the plateau. He reports: "Rising to a height of 2,000 feet from the monotonous plain of muskeg and lake, Horn mountain range roughly parallels the Mackenzie and disappears opposite Simpson. These hills rise gradually to a height of about 1,200 feet above the plain in a distance of about six miles. At this height the slope is truncated by a level strip averaging one and a half miles wide and then follows an abrupt rise of 400 to 500 feet to the top of the range which is a plateau, almost treeless, covered with caribou moss, and dotted with small ponds. The trees on the bare plateau show the effect of the prevailing winds. The limbs all point to the southeast and the northwest sides of the trees are scarred and limbless." On another expedition he proceeded some 25 miles up Rabbitskin river and thence continued overland to Horn mountains which he climbed. He reports, "Horn mountains in this area rise rather abruptly from the level plain to a height of about 1,500 feet. The ascent is made in a gentle slope of 300 feet in half a mile and an abrupt rise of 1,200 feet in 300 yards. From the crest the land rises very gradually for about a mile, then merges into the plateau which forms the top of the mountain. The plateau at this point is covered with stunted spruce (with some) poplar.

"From the summit a wonderful view is obtained. On the great level plain between the mountains and the Mackenzie only five small bodies of water were observed, a great contrast with the country seen from Horn mountains at their southeast end. Nahanni butte and the range of mountains extending north from it, were plainly visible though over 100 miles away and the detailed configuration of the escarpment south of the Mackenzie could be observed. Looking along the crest as far as the eye can see Horn mountains are seen descending to the plain in the same uniform, rather abrupt slope described above." As regards the timber, he says "As noted above in the Horn mountains area, a fire about twenty years ago swept the country which now is covered with scattered growths of poplar that have lately suffered again."

These two observations present a clear picture of the country lying to the north of the section of Mackenzie river between Great Slave lake and Simpson and reveal its two chief topographical features, the plateau country of Horn mountains and the uniform plains to the south.

The south boundary of Mackenzie valley is formed by the prominent drift-covered rocky escarpment—the continuation of the Caribou mountains. From Great Slave lake to a point 75 miles above Simpson the escarpment gradually approaches the river from a distance of twenty miles at the river entrance to

less than ten miles; through this portion a low lying swampy plain extends from the river to the hills. A number of fair sized streams rise on the plateau and descend from it in spectacular falls and cascades.

Seventy-five miles above Simpson a boulder clay area extending northerly from the southern plateau is cut through by the river. The channel through this section which extends nearly to Simpson is narrow and deep and the current is accelerated. This portion is known as "the line." The name refers to the fact that before the advent of steamers it was necessary to line or track boats up it on account of the strong current.

The lower valley land produces a considerable quantity of hay, and timber reaches good development on the boulder clay of the plateau, where, in general, conditions are similar to the wooded portion of northern Alberta.

The section of Mackenzie river above Simpson may be considered its main branch or north fork; with Liard river, joining it at Simpson, forming the south fork. Mackenzie river leaves Great Slave lake in a shallow spillway some thirteen miles wide. Its bed is littered with large boulders and the diffusion



PROVIDENCE, MACKENZIE RIVER.

The school and buildings of the Roman Catholic Mission are shown here. A typical northern settlement.

of its waters has prevented it from cutting out deep channels. For some distance it contains numerous islands with somewhat intricate channels between them. It then opens out into a lake-like expansion in which the current is checked and extensive shoals have formed. Below this expansion the river flows through a group of large islands with swift water in the main stream and rapids in the smaller channels, the stretch being known as "les îles des rapides." Providence is situated on the north side of the river below the swift water. In addition to the traders established here, there is a Roman Catholic mission school and a small farm on which it has been demonstrated that the soil is productive and the climate not too rigorous for vegetables and hardy grains.

Twelve miles below Providence the river expands to a small shallow lake called Mills lake, and below it for a distance of sixty miles it varies between one and two miles wide and flows through the low plain already described till it reaches the head of the "line."

At Simpson, Liard river flows in from the south and the river widens and loses the somewhat gorge-like character it possesses in the "line." Below Simpson the Mackenzie is truly a great river. Its flood discharge reaches 1,000,000 cubic feet per second which places it among the largest rivers of the world.

Liard river rises in British Columbia and cuts through the Rocky mountains carrying waters from both the east and west slopes. Excellent timber grows in its valley and along the tributary streams.

The Mackenzie valley section is not markedly different from the country to the south. The soil varies from sand to boulder clay. The severity of climate that might be expected from its latitude is tempered by winds from the mountains. The forests of northern Alberta persist with some restriction, hay grows abundantly, and potatoes, barley, and oats have been successfully raised to maturity.

The Northwestern or North Arm Portion.—As has been noted, North arm of Great Slave lake occupies the contact zone between the sedimentary and Precambrian rock and is a continuation in this respect of Slave river valley. The location of the northerly extension of this line is somewhat to the west of Marian lake and river. There is a marked difference in the soil and vegetation of the country underlain by the different formations. On the sedimentary rocks soil is deeper, finer in texture and more fertile. The plains extending to the



HAY LANDS NORTH OF PROVIDENCE

These meadows formerly supported large herds of buffalo and offer a possible future range for the herds of buffalo now being moved north from the Wainwright National park.

westward show an abundance and variety of vegetation including extensive hay meadows which formerly supported herds of buffalo, and a well developed forest growth representative of all the trees characteristic of northern Alberta, where it has escaped destruction by fire. These plains support an abundant fauna, including moose, woodland caribou, bear, and many fur-bearing animals.

To the eastward of North arm the Laurentian plateau rises with the ruggedness characteristic of its bordering zone. Its hill tops are usually bare and rounded with the bed rock exposed, and its valleys are full of lakes and swamps. A striking feature of country of this nature is a lack of continuity in its local topographical features; the hills are usually detached and the valleys often have no outlets. Broadly speaking, however, the country rises fairly uniformly to the plateau level of the interior uplands, where its general character changes. Timber in quantities sufficient for local requirements persists in the forests that maintain themselves in the enriched soil and shelter of the valleys, and the animals associated with the forests are to be found to the limit of the trees. The lakes abound in fish of the finest quality. The principal interest in this area lies in its mineral possibilities. Excellent samples of ore have been

obtained from the vicinity of Yellowknife river and Marian lake, to which regions prospecting has been limited so far. Increased facilities for travel and widened knowledge of the country in maps are stimulating activity in this direction.

The waterways extending from Marian lake northwesterly towards Great Bear lake are an important route for travel and give access to a great stretch of country. This route follows Marian river to its source whence a short portage across a divide leads to a series of large connected lakes whose waters finally discharge by Camsell river into Great Bear lake.

Marian river has two important tributaries, Rivière la Matre from the west rises in some large lakes at the base of Horn mountains. The district drained by this river has been an important hunting ground of the Dogrib Indians since knowledge of the country has existed. An eastern feeder, Petitot river, affords a canoe route to the open plains of the Coppermine district.

Another Indian route to the northeastern interior is by way of Busso river which enters Russell lake; and Franklin's route, by Yellowknife river and upper waters to Coppermine river, gives access to a district which has been found to be interesting to the geologist and prospector.

There is a considerable amount of travel from Resolution up North arm to the important trading posts at Rae. A choice of routes is offered. A crossing may be made of the open lake and the west side of North arm followed. This route is clear of islands and reefs but is lacking in good harbours. For protection from the prevailing winds and for the good harbourages offered most of the travel follows the outer islands across the lake and up the east shore.

North arm in addition to forming a geological boundary between the Precambrian and sedimentary rocks also marks an equally sharp division in economic possibilities; the conditions are characteristic of the Mackenzie valley to the west while north and east the country offers chiefly its fur and minerals.

The country east of Slave river included by the headwaters of Taltson, Thelon, and Snowdrift rivers.—The northeast-southwest trend of topography so strongly marked by the east end of Great Slave lake and its islands is maintained in the country to the south. This regularity of topography is lost on the drift-covered summit of the plateau, where the lakes spread out with great irregularity of bay and island and spill over the morainic ridges where depressions exist without well defined valleys.

The exploration through this country gave an interesting cross-section from Slave River valley through the bold, deeply scarred rocky border of the plateau, and across its summit, where the increasing depth of the drift deposit proceeding easterly more and more submerged the rocky framework of the country.

The forests of Slave River valley are well developed and include spruce, poplar, birch, and jackpine; but proceeding towards the rocky elevated country to the east, the trees become more scattered and less developed with a decided restriction of species. The poplar becomes small and scrubby, then disappears. Jackpines persist somewhat longer; stunted birch grow near to the edge of the trees; but only spruce continue as stragglers in sheltered spots at the edge of the open plains.

Portions of the headwaters of the three rivers travelled, Taltson, Thelon, and Snowdrift, flow through extensive tracts of pure sand, probably old lake bottoms, which usually support better developed timber. Snowdrift river in its descent from the plateau to Great Slave lake offers excellent water power sites.

The North Eastern or East Arm—Lockhart River portion.—Proceeding from Resolution northeasterly through Great Slave lake and from the lake through the rough country of the border of the Laurentian plateau, one passes from conditions known and familiar to a country in many ways new to his experience. There are points of resemblance between this journey and the ascent of a mountain of sufficient height to rise above timber line. There is the

same evidence of the struggle for existence in the forests and the plants, the elimination of the less hardy types, and a dwarfing and increasing sparsity of those surviving.

From Resolution to the site of Fort Reliance, Back's establishment at the eastern extremity of the lake, is a distance of about 250 miles with a choice of three routes through the islands. Back followed the one probably favoured by the Indians as necessitating few wide traverses and offering good shelter. It is known as the Inconnu channel and holds a middle course through the islands. There is also an old York boat route called the Hornby channel suitable for schooners, which follows the south mainland. For large craft the best course is to cross the lake to the north shore at Gros Cap, holding outside the islands and, thence, to follow the north shore. This route passes through the clear open reach of Hearne channel, which was shown as two bays on the maps previous to 1922.

In the early descriptions of this part of the lake it was noted that the islands were heavily wooded, but most of them have now been so badly burned over, that in many cases even the soil has been washed off. The islands are usually high and rugged, and in travelling through them vistas of hill, island, and



SNOWDRIFT RIVER CUTTING THROUGH BORDER OF PLATEAU

The rivers make the great drop from the interior plateau close to Great Slave lake.
They become unnavigable but afford good power sites.

headland charm the eye but confuse the navigator, unless the chart is carefully followed. As may be expected from the number of visible islands, submerged islands and reefs are numerous and necessitate constant care in travelling these waters.

After some 60 miles passage through the intricate waters of the massed islands, the lake opens up with long views to the northeast and east, the former leading to McLeod bay and the latter to Christie bay. The country rock among the islands is chiefly granite and gneiss, but proceeding up the northerly opening, a new formation is observed on Et-then island and Pethei peninsula. They consist of a variety of metamorphosed sedimentary rocks interstratified with and over-flown by igneous material. Either a faulting action or the effect of weathering on the steeply tilted formations has produced sheer northerly faces with steep pitches from the crest to the south. The cliffs are enlivened by the

colouring of the rocks with mosses and shrubs clinging to the ledges and fissures, and with the varied sculpturing produced in weathering. They present an appearance at once picturesque and impressive and make the trip along them one of outstanding interest. The north shore of the lake is formed by the massive Precambrian escarpment, which increases in altitude proceeding easterly from Gros Cap to the entrance of North arm. It swings in a remarkably regular reverse curve forming a flat letter "S" from Yellowknife river to the east end of the lake. The rise from the lake is abrupt, and though it is locally rough and broken by hill and valley, the broad horizons are regular. The northern slopes are lightly clad with timber; and the streams from the interior, having been unable to cut channels, fall over the escarpment in series of cascades and falls. They are unnavigable for some distance back from the lake.



MURAL CLIFFS OF ET-THEN ISLAND, GREAT SLAVE LAKE

This section shows the trap overflow with vertical, columnar fracture and the underlying, metamorphosed limestones and shales. Such cliffs feature the islands and coast line of much of the easterly end of the lake.

The country south of Christie bay is somewhat different from that north of the lake. The topography is more varied and broken and the interior plateau lacks regularity. Soil is deeper and timber better developed. However, knowledge of this part of the country is restricted to the immediate border of the lake, there being a great area to the south which is absolutely unknown.

The waters of the east end of the lake are a limpid blue, 10° F. colder in McLeod bay than in the westerly portion of the lake, and contain no sediment.

The great interior plateau which has an elevation about 700 feet above Great Slave lake approaches to within a few miles of the lake. The descent is abrupt and of a very rugged character. When leaving the lake to travel north or east, one is immediately confronted by this barrier. Due to the hardness of the rock, streams have been unable to cut valleys, and drainage takes the form of series of lakes spilling into one another. There is an extensive area on the plateau on which the topography is subdued and uniform. Proceeding from Great Slave lake a summit level for drainage is soon reached; beyond, the accumulated waters have gathered in a series of large lakes from which the final discharge, denied a natural outlet to the south, has been directed by accidents of topography easterly and finally south and southwest into Great Slave lake. This area will be considered later, but the situation explains the lack of rivers by which it would be possible to travel north from the lake. There are, how-

ever, several routes taking advantage of chains of lakes by which the journey north to the interior lake series has been made, but they entail too much portaging if the outfit carried is extensive.

The principal discharge from the interior, Lockhart river, flows into Great Slave lake at its eastern extremity through a valley which is a continuation of the great transverse valley of the lake. It makes the descent of about 700 feet from the plateau level in a distance of 25 miles. In its upper course it flows between bare, open, rocky hills with a succession of rapids, cascades, and falls. Its widening valley for eight miles back from the lake has been completely filled with sand to a depth of 600 feet. The river has cut a new course through the sand benches to bed rock and is still featured by rapids and falls.



SOUTH SHORE OF CHRISTIE BAY, GREAT SLAVE LAKE.

The high plateau bordering the lake on the south lacks the regularity of the northern escarpment. There is more soil and a greater development of timber here than along the north side of the lake.

An estimate made in August, 1923, gives the discharge as over 20,000 cubic feet per second. Though there is probably a considerable variation in the flow, it has great possibilities for the development of power. In the sandy valley of its lower course the vegetation shows the effect of shelter and enriched soil in its greater variety and more generous growth. Spruce are tall and hold their size to a good height, birch trees reach a sufficient size for canoe bark, and white poplar reappear in a few scattered clumps.

On the surrounding rocky hills and in the country to the northeast the soil cover is thinner and coarser. The hill tops are usually bare rock covered with boulders; but, in the valleys, where finer soil has accumulated and shelter is given by the hills, the forests survive but with increasing sparsity. There is an elimination of all but the most hardy varieties of trees and shrubs and these become more and more stunted.

Observing the vegetation as one proceeds towards the edge of the woods, the conditions determining this line become clear and logical. Where there is sufficient shelter from the winds, trees grow; and, with good soil and abundant moisture, they attain good development. As the two factors, soil and shelter, become less favourable there is an immediate stunting of growth till a point is reached at which plant food is too impoverished or the exposure to the weather too great and the seedlings cannot survive.

One finds as he proceeds that the rough topography of the border of the plateau gradually subsides. The hills are lower and more rounded, the valleys wide and flat; and, the mantle of drift soil which covers the country is deeper

and more evenly distributed. There is less enriching of the valley soil by that washed from the hills; and, the topography affords little shelter. With this change the forests disappear. The last stand of the forests is therefore largely a matter of topography. The trees persist to the limit of the rough country and will be found beyond, where the soil and shelter are favourable.

The ascent from Great Slave lake to the interior plateau may be made best by a portage route first described by Pike on his journey of 1890, and to which his name has been given. It leaves the lake near its eastern extremity and follows a chain of nine small lakes. The total carry on the intervening portages is about five and a half miles and anything which can be man-handled may be



PARRY FALLS, LOCKHART RIVER.

Estimated by Back (1833-34) to be 400 feet high and the most imposing sight he had ever witnessed. Though actually only 100 feet high it is impossible to imagine a more imposing struggle between a powerfully driven river and hard unyielding rock.

taken over. By Pikes portage route the distance from Great Slave lake to Artillery lake is twenty-five miles and the forests continue in straggling clumps for another thirty miles. Passing the last woods and leaving the rough land of the border of the plateau behind, a new type of country is entered, which has previously been called "the barren lands" but may more properly be referred to as the "northern plains," following the analogy of the plains of western Canada to which they bear some resemblance.

Interior uplands of the Northern Plains.—The portion of the northern plains included in the Great Slave lake district occupies the summit level of the interior uplands from which streams descend in almost every direction. To the south and west it is encircled by the rough country of the border zone of the plateau, which supports forests and is dotted with innumerable lakes with their discharge gathering into a number of small rivers.

The northern slope is a long low grade to the Arctic with no marked declivities, the uplands merging imperceptibly into the coastal plains. Eastward, a more abrupt drop is made to the great, low plain extending to Hudson bay. The uplands north of Great Slave lake are joined by a narrow neck which encloses the east end of the lake with the plateau south of Christie bay.

If the country could be viewed broadly from above, it would appear as a broad flat summit reached by the long northerly slopes from the Arctic, dropping more abruptly to the east and west, and with its continuity southward sharply broken by the valley of Great Slave lake. Due to the uniform elevation of a great area on its summit its waters have gathered into a series of large lakes, which discharge in the directions of its various slopes.

Although there is a wide area on the summit of a comparatively uniform elevation, it is locally rolling to hilly, with the appearance of the sea after a storm. An endless succession of short low hills extending to the horizon accentuates the impression of vastness by the lack of outstanding features. Some variety is given by the character of the hills. Those, in which the underlying granite outcrops have rounded contours and hold fairly regular northwesterly courses across the country. The drift hills are also smooth in contour, but occur either as isolated buttes shaped somewhat like bee hives or as narrow ridges, also lying northwesterly.

In general, the lake series occupies the country included between granite ridges on the south and lines of drift ridges on the north; and, conforming to the irregular local topography, the lakes are featured by a confusion of islands, points, and bays. The trend of topography is continued northwesterly by Coppermine river and to the southeast by Hanbury river. There is also a drainage at right angles to this line. Lake MacKay and Back lake lie on an elevation to the south and drain northeasterly to Aylmer lake; and Back river rising near the northern extremity of Aylmer lake flows in the same direction to the Arctic, while Yellowknife river on the west and Lockhart river on the east both flow southwesterly.

The broad survey shows the position occupied by the uplands in the general country slopes and a closer view reveals the detailed configuration of the country, the nature of its topography and the distribution of its water. Another general impression is that of its surface cover. The blue of its waters merges into the light green of their grassy margins and valley lands, and these shade into the dark green of the shrubbery of the hills, broken by the varicoloured mosses and the grey of boulders and rock outcrops. There is little suggestion of barrenness in the field of view other than the rock exposures and scattered dumps of morainic boulders.

The waterways of the upland area reach to all parts; and, by the radiating rivers access is given to the vast stretches of the northern plains lying between it and tide-water in the Arctic ocean and Hudson bay.

The line marking the edge of the forests in the Great Slave lake district crosses Artillery lake near the centre and extends westerly crossing the south end of lake MacKay. From there it swings north holding to the west of lake MacKay and lac de Gras and crosses Coppermine river at the east end of Point lake.

Artillery lake is reached from Great Slave lake by Pikes portage. The southern end of the lake extends into the high rocky border of the plateau in a long narrow bay with the hills rising abruptly from it to a height of two or three hundred feet. Viewed from the lake the country appears rugged and forbidding; but on climbing the hills, it is found that the bare hills enclose grassy valleys dotted with lakes and ponds and usually with clumps of trees.

Gradually the abrupt topography subsides to a plain of low relief with long moderate slopes and wide flat valleys. Rock outcrops become increasingly rare and the boulders which feature the hills of the plateau border are more and more imbedded in the deepening drift cover. An analogy might be drawn in the case of a river approaching a cascade; the smooth stretch of water breaks when nearing the obstruction and falls tumultuously over it. Just as it is with a sense of relief that the traveller clears the broken water and enters the quiet reach above, so will he experience a similar mental reaction on entering the undulating and rolling plains of the uplands after crossing the rugged border zone. Proceeding northerly through the sixty mile stretch of Artillery lake,



SOUTH END OF ARTILLERY LAKE

The southern end of the lake extends into the rough country of the border of the plateau as a long narrow arm surrounded by hills rising abruptly 200 to 300 feet. Proceeding up the lake the hills flatten out and with the change of topography the forest disappears.



DWARF SPRUCE TREES, ARTILLERY LAKE.

Leaving the shelter of the hills, the trees become more scattered and more stunted and finally disappear. This view indicates the grim struggle for existence. The outlying dwarf trees seldom exceed five feet in height.

twelve miles of lake-like expansions of Lockhart river all regular in shape occupying shallow depressions and joined by narrows in which are rapids, then sixteen miles along Ptarmigan lake brings one to the northern limit of the sandy plain. At some points wind-blown dunes and at others glacial moraines give rise to a varied surface topography. In the occasional clumps of shrub and low dwarfed spruce growing in the shelter of the hills one witnesses the grim struggle for existence of the lingering forest; and finds at the middle rapid between Artillery and Ptarmigan lakes a venerable spruce overlooking the river which was noted by Pike in 1890 and has existed beyond the memory of the oldest Indians.

The drift plain ends at a massive granite ridge, at the north end of Ptarmigan lake, which marks the change in the course of the waterways from northeast to northwest, and a change to a more hilly topography. This barrier is passed by a narrows with swift water and Clinton-Colden lake is entered. By a short portage from the southeast bay one may cross the height of land to waters draining to Hanbury river, which is 165 miles long, and forms one of the main sources of Thelon river flowing to Hudson bay. Hanbury river rises in lakes on the sandy plain and its course is featured by lake expansions with rapids in the stretches between, making a drop of about 800 feet. In its lower reaches it enters a sandstone country; and, with the change in the rock formation, there is also a well marked variation in the character of the country and its vegetation. Groves of trees, extensive grassy lowlands and many new varieties of flowering plants give the country a more lively and verdant appearance. Thelon river flows through the broad low coastal plain country and discharges into Chesterfield inlet. It passes through boulder clay areas on which there is a revival of the forests, great stretches of hay lands, and a reappearance of woodland life.

The waterways made up of Clinton-Colden and Aylmer lakes differ only slightly in elevation and are similar in general character. The hills extend into the lakes in points continued by islands and reefs, while deep bays occupy the valleys. The water is remarkably clear, a white object being visible to a depth of fifty feet.

Comparing Clinton-Colden lake as determined by the survey with Back's map, it is possible to identify his main points and to understand his suggestion of islands and bays; but in the case of Aylmer lake one is at a loss to understand how he could have seen it as his sketch shows it. Only two views show a water horizon, westerly into the narrow west arm and northerly to Sandhill bay. Although he travelled the latter four times with the west shore in plain view he showed an open sea extending westward to an indeterminate shore.

From Aylmer lake three routes diverge. At its northern extremity a low swampy divide separates it from one of the head-water streams of Back river, draining to the eastern Arctic: while, from its west bay a stretch of thirty miles of river and lake expansions, forming upper Lockhart river, leads by lake MacKay to the southwest. A northwesterly portage route through a number of small lakes and one large one reaches the headwaters of Coppermine river at lac de Gras.

In proceeding to lake MacKay the northwesterly line of the granite ridges is crossed and a wide drift plain similar to that of Ptarmigan and Artillery lakes is entered. The soil cover is not deep and the granites which usually underlie it are remarkably level. An elevation of 100 feet stands out prominently from the plain. A total rise of about 200 feet is made in the river, distributed in a number of boulder rapids and one heavy cascade over a granite ridge. The river has no valley and the low boulder ridges enclose its lakes and give rise to the rapids at the points where the river crosses them.

Lake MacKay has been shown on previous maps as a great open body of water one hundred miles long and twenty miles wide. Actually it is about sixty miles long and is narrow, shallow, and sinuous. It is similar to Ptarmigan lake in its regular shape and the moderate rise of its shores to the featureless

undulating plains in which the greater portion of it lies. Approaching the south end of the lake, the high rocky country of the plateau border, similar to the south end of Artillery lake, is entered. The lake loses its regular character and one finds again a condition of uncertainty of headland, bay and island, till finally the lake loses itself among the hills. From a prominent observation point at the south end the view is again characteristic of the border zone; a confusion of hills stretches to the horizon south, east, and west, with glimpses of lakes of indeterminate extent in the valleys. The forbidding appearance of the rocky summits is relieved by an increased development of vegetation in the valleys, grass in the lowlands and hazel and alder on the hillsides, with a reappearance of spruce in the sheltered valleys, the shrub types, the dwarfs, and scattered clumps of well developed trees; while, on a distant southern sky line, the hills themselves may be seen to be timbered.



EDGE OF FOREST, SOUTH END OF LAKE MAC KAY

Proceeding southerly along lake MacKay as the rough country is reached timber reappears in the valleys and increases in size and extent to the south. The trees of this grove are about 6 feet high.

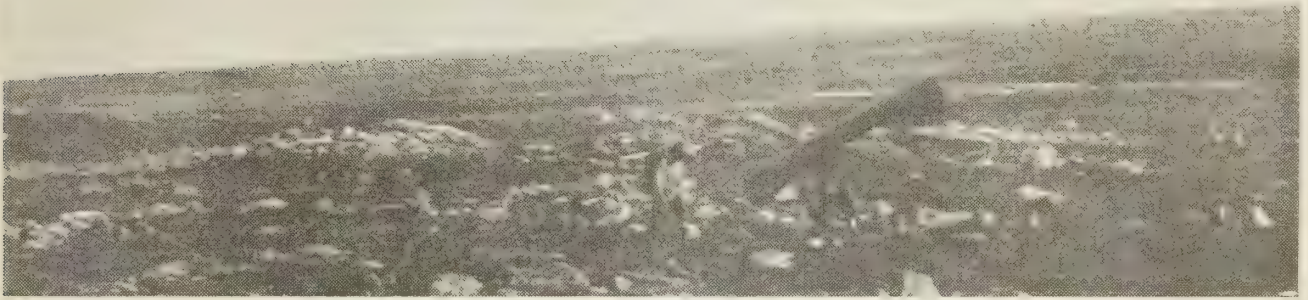
The southern extremity of lake MacKay was found to be over fifty miles southeast of its supposed position, which leaves a gap of unknown country about seventy-five miles wide extending to Yellowknife river. Hearne's track probably crossed this area when he proceeded from Point lake to Great Slave lake crossing a succession of lakes and finally a stream which discharges into Great Slave lake near Gros Cap.

In discussions with Indians about lakes of uncertain size and location in little known country, ambiguity often results. The map may indicate a large lake, such as MacKay, standing out prominently in the blank unexplored country surrounding it; and, it appears to be a simple definite point. To the Indian, however, with his mental map, the country is full of large lakes, which are not clearly distinguishable by a description of size, but must be identified by some event with which both parties are familiar. For instance, the locality in which Franklin's men died on the return trip from the Arctic is well known as "the place where the white men died"; a lake may only be identified to them as "the lake where the people starved", or, "where a certain Indian was once met." This is a rather important consideration when travelling with Indians or by Indian information, otherwise confusion will result. There was no means to describe lake MacKay to the Dogribs of North arm, as to them there were "too many big lakes" there; while, to the Yellowknives of the east end, it was clear as the "place where the big canoe was left."

The third route, from Aylmer lake to the Coppermine river, follows the Upper Lockhart river to the first big lake, and thence a northwesterly portage route of about fifty miles is followed to lac de Gras.

The route followed was probably a post glacial river channel and is now represented by chains of small lakes. An interesting point in connection with them is that the various streams rising in the lakes along this route form parts of the headwaters of the three great rivers of the north, Mackenzie river of the western Arctic, Coppermine river of the centre, and Back river of the eastern Arctic; and at each of the low divides there are lakes which probably seep both ways.

The first series of lakes extends to the hills that enclose Lockhart river valley on the north, and lies in a generally hilly country, flattening to the southeast. Another series of lakes lying in the hills drains easterly across a wide undulating valley to Aylmer lake. By another low divide with a number of ponds and small lakes, a large and remarkably irregular lake is reached. This drains easterly and is probably the principal source of Back river. From its location and the sandhills which feature it, it has been identified as Hearne's Thonokied lake. From the western extremity of this lake, following a chain of small lakes along the sandhills, lac de Gras is reached. Its water level is about fifty feet higher than that of Aylmer lake.



EXPLORING PARTY ON THE MARCH

Crossing the divide from the headwaters of Backs river at Thonokied lake to the head of Coppermine river at lac de Gras. The caribou migration was drifting westward along the distant grassy ridges.

Lac de Gras is some fifty miles long from east to west. Its south shore is regular and generally rises gradually to a low plain. At the west end of the lake the rugged country of the border zone is once again reached and is featured by granite ridges and grassy valleys. At Point lake, not far to the northwest, the outposts of the forests are reached. Coppermine river breaks through the enclosing hills of the west end of lac de Gras in a series of rapids.

The north shore of the lake is much more irregular than the south, both in the shore line and in the country extending back from it. Bays and connected lakes extend northward, the land surface consisting of a series of granite ridges and sandhills with wide grassy valleys intervening.

A general impression which will be received in travelling the interior uplands, is that of viewing a country in its early stages of natural development. Its waterways are made up of lakes spilling uncertainly from one to another without well defined channels. The weathering of the surface soil is very incomplete and has not penetrated deeply, while the vegetation responding to the soil conditions varies from primitive moss types to grasses and shrubs of a more highly developed order.

The district has been considered in some detail in the light of information gathered in representative sections. From this review certain conclusions stand out with regard to the values the country has to offer.

The district was first opened up in the interests of the fur trade which still dominates its business activities and supports its inhabitants. With the application of sound principles of conservation, the fur of the district should remain indefinitely a valuable resource. It should offer a field for fur farming, where the fur bearing animals could be raised under their natural conditions.

The greatest speculative value lies in its mineral and oil possibilities. Should there be a find in either field of sufficient value, the disadvantages which retard developments in the district would be easily overcome. The southwestern section is underlain in part by oil-bearing formations; the contact zone of North arm has revealed mineral deposits; while some development work has been performed with satisfactory results on Wilson island, Great Slave lake, on the property of the Aurous Gold Mining Company. In the Laurentian area, minerals are associated with intrusive veins and metamorphic rocks. The situation in places may be said to be quite favourable for minerals; and, the waterways give the prospector access to a great extent of country.

The forests will not more than meet local requirements, except as a future reserve for pulpwood. In the Slave-Mackenzie valleys the soil has been demonstrated to be suitable for restricted forms of agriculture, which classify it as a future reserve area. The whole district has possibilities for range lands. Excellent wild hay grows at certain points in Slave and Mackenzie river valleys. While throughout the open plains of the north there are extensive areas of hay lands in the valleys.

The quality of fish improves in colder water; and, to a certain extent, northern fisheries are richer than those of more southern latitudes. There are possibilities for commercial fishing in the North, when the transportation problem is solved by a general increase of business, warranting additional facilities and consequently lower rates.



FISH FROM GREAT SLAVE LAKE

One night's yield from one net. Whitefish to left, trout above and pike below. In the cold waters of this lake these fish reach their greatest development and are unsurpassed (elsewhere) in size and quality.

It would be as unwise to make sweeping claims as to the values the country has to offer as it would be to ignore its possibilities. The outstanding facts are that present business activities have warranted the introduction of modern transportation facilities into the district. Possible extraordinary values in oil

and minerals are already engaging the attention of business men; and, there would be no insurmountable difficulty in developing them, should discoveries be made; and, there is substantial promise in the soil, vegetation, and fisheries for the future. The severity of the climate may restrict activities, but not to a prohibitive degree either in agriculture or industry.

The knowledge of the area gained from the surveys has removed it from the realm of tradition and guess work; and, while exposing the adverse conditions, has revealed the fact that its general character justifies investigation to furnish indications as to the part it may play in the economic development of the country.

CHAPTER IV

SETTLEMENT AND TRANSPORTATION

Settlements.—There are settlements at six points where business, chiefly in the interests of the fur trade, the missions, and general administration, is carried on.

These are at Fort Smith, on Slave river the headquarters of the Mackenzie district, at Resolution, Hay River and Rae, on Great Slave lake, and at Providence and Simpson, on Mackenzie river. A wireless telegraph station has recently been established at Simpson and another at Fort Smith. These will be of material assistance in removing the isolation of the district, in assisting business and promoting development.

Indians.—The Indians living in the district originally belonged to three main tribes, the Slaves, Dogribs, and Yellowknives. These all form part of the Dineh nation which included all the various tribes inhabiting the north woodlands and plains between the country of the Bush Crees and the Eskimos of the coast. The history of these people remains to be written. Their origin is probably Asiatic. Their wars with the natives to the north and south, and amongst themselves, and their life, in a country in which there were periods of food scarcity caused them to be strongly nomadic and gave rise to high mortality amongst them.



POTATO FIELD, HAY RIVER MISSION.

The excellent alluvial soil at the mouths of the rivers emptying into the west end of Great Slave lake supports a good growth of timber, and when the land is cleared, heavy crops of hay and garden produce are grown.

Generally speaking, these people were found to be timid and inoffensive. They appear from, the most reliable accounts, to have welcomed the trader and readily accepted the teachings of the missionary. Their mentality is not of a high order, and in the past they did not set much value on human life. Their socialistic practices with regard to ownership of property were carried to the extreme, resulting in absolute poverty and improvidence.

Since the establishment of trading posts and missions amongst them, their mode of life has been considerably changed. They have small settlements scattered along the waterways at which they have houses; and, the possession of permanent abodes, although they may spend only a small part of the year in them, has raised their standard of living. The possibility of retaining and protecting the rewards of labour has developed individual industry. The increased value of furs in recent years has brought prosperity to the good hunters.

Through the years during which these Indians have been known, they have changed from great travellers, spending the entire year moving with the caribou or seeking good fisheries, to a people of settled communities, carrying on their business, still largely hunting and trapping, from these centres. The loss of their roving characteristics and their former complete self-reliance in maintaining themselves, has been accompanied with a certain physical and moral decline. They lack the enterprise and stamina required by their former method of living; but, on the other hand, life is for them simpler and more secure. The wars which formerly harassed them have been completely stopped; but they still retain the tradition of the enmity of the Eskimos and will not venture into their country.



TYPICAL INDIAN SETTLEMENT, GREAT SLAVE LAKE

The Indians of Great Slave Lake district now have permanent abodes. Though they may live only a small part of the year in their houses, the possession of property has raised the standard of living and developed individual industry.

When the district was first known, the Yellowknives were the most powerful people and claimed the best caribou passes and the most productive fisheries, but about 1830 the Dogribs rose against them and nearly exterminated the tribe and they never recovered from this reverse. The Dogribs to-day seek to isolate themselves from outside influences, and retain many of their customs and the independent life of their forefathers. They inhabit the country of the north arm of Great Slave lake, westward to lac la Martre, northerly to the vicinity of Great Bear lake, and northeasterly to the Coppermine river. A number of families also spend much of the year in the country of upper Taltson river. They are good hunters and trappers and the fur collection shipped from Rae, where they trade, is amongst the most valuable in the north.

The Slave Indians inhabit the south shore of Great Slave lake and Mackenzie river as far down as Simpson. They have always been fishermen and lacked the virility of the caribou hunters. Although their name is applied to the lake it is only since the arrival of the traders. The original Indian name was "Athapuscow" by which it was known in Hearne's time. This is the Cree form of "Big lake."

The Yellowknives inhabit the country eastward from Resolution and throughout the easterly arm of the lake. On account of considerable intermingling with the Chipewyans to the south, they have lost their distinctive racial characteristics. A few of the older men suggest those qualities commented upon by Franklin and Back. Both the Yellowknives and Dogribs were originally caribou eaters and used caribou hides for clothing. They did little or no trapping and fished only when caribou were not to be had.

The country between Great Slave lake and lake Athabaska is chiefly inhabited by "Caribou Eaters", a branch of the Chipewyan family. Like the Dogribs of North arm they have held to their primitive life, seldom visiting the trading post. Their country contains many lakes, excellent for travel and containing fish of the finest quality; and it is one of the great fall and winter ranges of the Northern Plains caribou. Moose are also numerous in many parts.

The relative strength of the three people is indicated by the Indian Treaty figures which give the Dogribs 959, Yellowknives 200, Slaves 731.

Situation of district with regard to transportation.—Edmonton is at present the chief distributing point for the country to the north and it offers facilities for outfitting of almost any character and to any amount. Leaving Edmonton by the Alberta and Great Waterways railway a journey of 296 miles brings one to the upstream end of steamboat navigation at Waterways, six miles up Clearwater river from its junction with Athabaska river. A good steamboat service is maintained between Waterways and Fitzgerald at the upper end of the rapids above Fort Smith. This route follows Athabaska river to lake Athabaska, crosses its westerly extremity to the historical establishment of Chipewyan and descends Slave river to the rapids at Fitzgerald. The distance from Waterways to Fitzgerald is 270 miles. The passage of the rapids entails an overland journey of sixteen miles, from Fitzgerald to Fort Smith, but modern equipment consisting of tractors, trucks and automobiles, has simplified the operation of transferring passengers, baggage, and freight from the steamers above the rapids to those operating below.

There is no obstruction to steamboat navigation between Fort Smith and the Arctic ocean, a distance of 1,400 miles. This journey includes the descent of Slave river to Great Slave lake, the crossing of the western portion of the lake to Mackenzie river and the journey down it to the sea. The season of navigation includes the period from the breakup of the ice on Great Slave lake to the latter part of September when low water in Athabaska river makes it necessary to close navigation with steamers. Mail and other business from then till freeze-up is handled by gasolene boats.



THE OPENING OF NAVIGATION AT FORT SMITH, N.W.T.

The head of 1,400 miles of unrestricted navigation by river and lake to the Arctic ocean. The steamers shown here are loading for the first trip of the season and it is interesting to note that the auxiliary schooners in foreground are for delivery to Eskimos of the coast.

Local business to points on Great Slave lake is carried on by auxiliary schooners and high power gasolene boats pushing scows. It is possible to arrange for the delivery of passengers and goods at any point in the area which may be reached by boats operating on the waterways.

The navigation of the lake has been greatly assisted by the construction of land beacons at the entrances to Slave and Mackenzie rivers, and range lights giving entrance to Hay River harbour. Buoys are set during the season of navigation, marking the channel through the shoal water at the river mouths. The charts of the waterways prepared from the control surveys indicate the best routes, dangers to navigation, and the location of harbours and shelters.

TABLE OF DISTANCES

	Miles
* Edmonton to Waterways (railway)	296
* Waterways to Fitzgerald (steamer)	270
* Fitzgerald to Fort Smith (motor transport)	16
* Fort Smith to Resolution (steamer)	200
* Resolution to Mackenzie river (steamer)	110
* to Simpson (steamer)	309
to Rae (schooner)	177
to site of Fort Reliance (schooner)	214
Site of Fort Reliance to Artillery lake (portage route)	30
to North end Artillery lake (Lockhart river)	81
to North end Ptarmigan lake	107
to Hanbury portage	111
to Thanakoie	144
to Back river	181
to West end Aylmer lake	185
to North end MacKay lake	212
to Southwest end MacKay lake	291
to East end lac de Gras	236
to West end lac de Gras (Coppermine river)	282
Clinton-Colden lake to Thelon river by Hanbury river	165

* Regular service in operation.

CHAPTER V

CLIMATE AND VEGETATION

Climate.—In the Great Slave lake area there is a sharp division between the northeast and southwest in the geology, topography, soil, and vegetation. There are also strikingly different meteorological conditions prevailing in the two regions. This is largely due to the fact that the prevailing winds of the Mackenzie valley are from the northwest, bringing with them the tempering influences of the mountains; while, in the eastern portion of the country, northeast winds prevail, blowing without obstruction from Hudson bay and the Arctic ocean. In Mackenzie valley region the proportion of water to land is small and has an inconsiderable influence on the climate; while the northeastern section (including Great Slave lake) contains a great deal of water where the lingering ice retards spring and early summer.

The setting and disruption of ice in the upper Mackenzie varies between November 15 and 30 for the former, and May 5 to 20 for the latter, giving approximately six months open water. The dates for Great Slave lake vary in different portions but are approximately, Resolution, October 15 to November 15, June 1 to 20; Rae, October 5 to 25, May 25 to June 15; Site of Fort Reliance, October 1 to 20, June 25 to July 5.

From observations made during this and previous years the following description is given of the ice phenomena on Great Slave lake: Great Slave lake is made up of the open body of the west end, the broken waters in the massed islands and the long narrow bays of the east end. The lake bottom is uneven and the streams flowing into the lake set up currents. It is apparent therefore that different conditions prevail on the various portions of the lake governing the setting and disruption of the ice.

Normally ice forms about the latter part of October, but outside the sheltered bays, and among the islands, the heavy fall storms keep breaking it up. All through November and December this process continues and the heavy ice encroaches farther into the open lake. It is not considered safe for travel except along the shore till about Christmas. Should the ice form and break up many times, with the broken cakes of early ice cemented by the latest, often in great confusion, very rough ice will result. It is said that some winters the centre of the lake never freezes over but this is doubtful.

During January, February, and March high winds drive and pack the snow and under the thin cover the frost penetrates deeply, forming ice of great thickness—six to eight feet. With the formation of heavy ice the increasing pressure causes anticlinal (upward) folds which fracture along the peaks. These pressure cracks sometimes extend many miles and form serious obstacles to travel. *Spring* conditions generally commence in April though this season is very erratic in this part of the country; finally, the surface snow melts, the shore ice weakens, and that of the open lake “candles” and develops cracks. At this period it is very difficult to travel on account of the slush and water on the surface, the sharp points of the candled ice, and the dangerous cracks which may freeze over lightly.

Through the spring the rotting continues interrupted by periods of sharp frost of the lingering winter. The factors causing the breakup of the ice in addition to the rising temperature are rain and wind, particularly the latter. The lifting action of the water flowing in from the surrounding hills loosens the ice around the lake margins, and soon open water, there and along the fissures, permits the winds to give the loosening ice fields a little play. When this condition is reached, the first heavy storm is liable to drive the ice before it. The tremendous pressure of the fields piles it up on lee shores, while the grinding of

mass on mass furthers the disruption, and the increasing open spaces permit of greater movement with the shifting winds of spring. The speed at which the loose fields travel is sometimes incredible, and the momentum is irresistible. The period of drifting ice fields is dependent entirely on the winds, for the ice must break itself up to offer many surfaces to the sun and waves.

The date at which the ice moves out is uncertain. Open water will appear first in early May, at points where there are currents—the mouths of the rivers and the narrow places. North arm will probably go next, towards the end of May, but the loose ice drifts backwards and forwards across the bay and hangs on the outer islands. This will be followed by the disrupting of the great body of ice of the west end, usually in early June, and about the same time it clears in the archipelago and Christie bay. Two or three weeks later McLeod bay will usually open up—about July 1.

The earliest date at which a crossing has been made from Slave to Mackenzie river with large boats is June 8, while the crossing has been made through drift ice as late as the first week in July. The date generally accepted as the earliest on which the journey may safely be made is June 20. It must always remain a matter requiring good judgment on the part of the officer in charge. He must take into account the general conditions of spring and the weather immediately preceding. It is a good practice in the spring when proceeding from Slave to Mackenzie river to follow a southerly wind, which will have moved the ice to the north shore; or, in the case of the trip from Slave river to Rae on the North arm, it is well to follow a northeaster which will clear the easterly route through the islands.

Vegetation.—Large bodies of ice retard growth in the early season, but this is compensated for to a certain extent by the long hours of daylight in summer. Since the sun is above the horizon almost the whole of each 24 hour day, it is difficult to conceive of a summer frost ever being possible, and plant growth is practically continuous. It may be said that the vegetation literally jumps forward from early spring to midsummer in the vicinity of the large lakes.

In the Slave-Mackenzie valley country the seasons are not markedly different from those of northern Alberta, other than that winter is slightly prolonged and starts earlier; and that there is a lowering of mean temperatures throughout the year.

To the northeast the winds and spring ice complicate the seasonal changes and introduce conditions of an uncertain character. The severity of the climate in the northern plains is a factor that must be reckoned with in planning development and, while it does not control, it restricts activities.

Trees.—The vegetation of the various sections has been noted in Chapter III; but a broad survey of the whole district in its forest aspect presents some interesting information. While spruce is the chief tree of commercial value, poplar is more sensitive in marking the limit of certain conditions.

Poplar is found throughout the Slave-Mackenzie area, except on the Horn mountain plateau. It is not very common in the Laurentian country, but is found in favourable situations, even where these are a considerable distance from the nearest poplar forest. Approaching the limit of its range, it becomes crooked and small in proportion to its height, and in general appearance bears little resemblance to the poplar in favourable situations.

Black poplar is more common in the Laurentian area, usually occurring on southerly slopes near water; it is long, thin, and bent towards the southwest. Spruce both marks the edge of the forests and maintains good development farthest. In favoured spots near the "last woods" excellent trees are found; but where exposed it is either almost flattened against the ground, being bent away from the prevailing northeast winds, with the root and lower trunk protected by a heavy growth of long low branches; or else it tapers abruptly from a heavy butt to a slender tree, usually dead and blanched at the top. In its

extreme locations it occurs as small, dense, circular clumps with trees an inch or so in diameter and one to six feet high; or again, as what might be called a bush rather than a tree, about a foot high, with its branching roots covering a wide area and growing at the water's edge. An interesting point is the definite information given by the trees on the direction of prevailing winds. On Horn mountain plateau for instance the trees indicate that the northwest winds of the Mackenzie valley prevail, while to the northeast, as already indicated, the trees flatten away from the prevailing northeast winds from Hudson bay and the Arctic regions. Tamarack is closely associated with spruce and grows in swampy valleys to the edge of the timber. It is usually stunted, but fair specimens may be observed throughout the timbered country.

Birch is economically important as the only hard wood and for its bark. It is native to the whole district but requires shelter for normal development. The white or canoe birch is found in a slender and crooked form nearly to the "last woods", while the scrub black birch grows as a low bush throughout the open plains. It is the last resource for fuel, where there are no willows, and when the moss is wet.

Jackpine is a straggler in the Laurentian area and was not observed on the northern uplands. It is one of the principal trees of the southwest, especially on sandy soil.

Alder, hazel, and a number of species of willows form a heavy underbrush in the woodlands of the southwest and are found to the limit of the trees. Alder and hazel do not grow beyond this limit, but willows may be found scattered throughout the open plains, growing at the water's edge, with their roots submerged. They usually occur as low bushes about a foot high but in favoured localities may reach a height of five or six feet. The spring ice breaks off many of these and shoves them above high water, where they dry and form a welcome but uncertain fuel supply.

Wild Flowers.—The profusion of wild flowers growing in the rocky portions of the Laurentian area and on the open plains is very striking. They exhibit variety of colouring and delicacy entirely out of keeping with the term "barren" applied to the country.

Grass and Range Land.—There is a close relation between moisture and grass growth. A country in which precipitation is light, or in which the soil is coarse and loose and permits a rapid absorption of moisture produces little or no grass, while on well-watered land which retains its moisture, grass grows well. Grasses grow quickly and mature early; and therefore, a long winter will not prohibit growth if the growing season is favourable.

Consider the grass growth of the western prairies. Rainfall is generally light and the topography varies from undulating to rolling. Absorption is slow where the soil is heavy, and the waters of the hills gather into lakes and sloughs in the valleys. Where the soil is light and sandy the moisture is rapidly absorbed and periods approaching drought wither the vegetation. Grass in the valleys is inclined to be coarse and luxurious, while on the hills it is short, wiry, and sparse. On the high lands of the foothills there is a strong wiry tufted growth called "bunch grass."

Coming to the woodlands north of the prairies, moisture is heavier and better conserved, but openings where grass can grow are of limited extent. This country may be generally considered potential hay land where hay will grow if the woods are removed or the mossy swamps drained.

In the rocky border of the Laurentian plateau the coarseness or the lack of soil largely controls grass growth. Beyond, in the open country of the northern plains, there is a certain analogy as to grass growth to the southern prairies. Here are lakes and swampy valleys, but, instead of the coarse slough grass of the south, due to the northern climate, the grass of the lowland resembles rather the bunch grass of the foothills. On the higher land the soil is often too coarse to retain moisture and supply the required plant food; and, therefore, the grass

growth becomes sparse or entirely lacking. Proceeding northeasterly the proportion of valley to hill increases with the flattening topography and there is an improvement in the soil. Consequently there is an increase in the proportion of grass lands and an improvement in the quality of the hay.

It may be taken, therefore, that most of the northern woodlands can produce hay if the country is opened up; and that on a large proportion of the open plains grass grows naturally. In considering the possibilities of these hay lands for grazing purposes, another aspect is presented. Proceeding northward from the western prairies the problem of winter feeding becomes more and more serious. The winters are longer and more severe. Freely ranging animals solve the problem by migrating south in winter; for domesticated animals this movement could only be avoided by storing supplies in summer for feeding through the period during which the natural range is not available.

The problem has had to be solved all over the world. As a country becomes more intensely settled and developed, its range lands that have agricultural value are cropped, and the stock is maintained largely on cultivated food or is forced into less desirable country—the higher slopes of the hills or the outlying districts. With intensive settlement of the country it will become increasingly important that new range lands be found. In supplying this need it may be necessary to draw on the hay resources of the north country and to meet and solve the problem of winter feeding, either by cultivation or seasonal movement.

CHAPTER VI

ANIMAL LIFE

The three zones, Canada, Hudsonian, and Arctic (See Chap. I) are featured more distinctively by their fauna than by their flora. The Arctic is characterized by the absence of forests and the presence of certain mammals, as the muskox, the Northern Plains caribou, the Arctic fox, and the Arctic hare. The Hudsonian zone is largely one of overlap. Coniferous forests feature it though jackpine is seldom found. Poplar is not a prominent species and barely enters the region. The mammals of the Canada zone range to the limit of the trees while those of the Arctic enter its woodlands in winter.

MAMMALS

All forms of animal life typical of the Canadian woodlands may be considered native to the Slave-Mackenzie area. Perhaps the most interesting species of this section of the country is the Wood buffalo. In the early days they ranged the country in large numbers west of the Slave river--North Arm line. South of Great Slave lake and Mackenzie river their habitat probably extended westward to Liard river and eastward as far as Taltson river. To the north it included chiefly the district extending down stream on Mackenzie river as far as Horn river and northward to lac Martre and thence easterly to Marian lake. A half-breed living at Resolution stated that until about fifty years ago his father each year put up Buffalo meat, for the winter's use, in the country north of old Fort Providence at the outlet of Great Slave lake. Finally one winter the buffalo all crossed to the south shore and never returned. In recent years the buffalo ranging between Peace river and Great Slave lake west of Slave river have come under observation. A reserve has been set apart for them; they are given protection by law, and their range is patrolled.

Information on most of the arctic mammals has been given to the public at various times and it is not the intention to more than touch on them in this review.

The Northern Plains caribou however calls for special treatment because of the dearth of exact information regarding this species. The Northern Plains caribou (*Rangifer arcticus*) is the animal which gives most character, biologically, to the open plains. They have been met and studied at certain widely scattered points and at different times; but their range of migration is so great and their habits so erratic, that there is an air of mystery about them which is remarkable when it is considered that, of the large mammals of the world, they alone survive in anything like their original numbers on a large part of their former range and live the life of pre-historic times. The Indian recognizes the mystery shrouding their movements by saying, "They are like ghosts, come from nowhere, fill the country, and vanish."

There are two questions that present themselves in connection with the caribou. How many are there? What are their movements? The answers to both questions are largely speculative and based on the most meagre data. The country to the northeast of Great Slave lake is a good district in which to observe them, as one of the most important migrations passes through it in the spring and fall, and large numbers winter in the border zone of the woodlands.

From observations made and information gathered from the natives of the country, the caribou year cycle appears to be somewhat as follows: The greater number of them winter within the edge of the woods, in country sparsely

timbered and on which the caribou moss grows abundantly, for this is practically their only winter food. Sometime in February the cows and the calves born the previous season start their northerly migration, travelling in large bands and holding to recognized routes. These are usually determined by the location of winter feeding grounds, the caribou moss growing most abundantly on the rocky hills. It has been noted that spring trails, which are distinguished from those of autumn by the fact that the moss of the lowlands is deeply tracked but not broken, hold fairly direct northerly courses, crossing the large lakes at narrow places and passing through hilly country. This northerly movement of the cows is directed apparently by a strong instinct to reach the vicinity of the Arctic coast for the calving season in early June.

The bulls do not leave the woods till much later, following the retreating snow. Reaching the open plains, they scatter widely and spend the summer season often singly or in twos and threes. Their movements at this season are very erratic. The flies bother them greatly, and their only relief is to travel "up wind." Their gait is a swift trot, and their feeding at this time consists of a series of snatches. This swift travel and the varying winds of summer largely account for the wide-spread scattering at this season. Their heavy winter coat of greyish-white becomes ragged and patchy and normally



CARIBOU ON SUMMER RANGE

In summer the caribou feeds chiefly on the grass which is found extensively in the valleys and along the lake margins.

is shed completely by early July when they become a sleek brown with white on the chest, belly, and rump. The larvae of the bot flies deposited in the hair of their back in summer hatch and puncture the hide and cause much suffering during the following winter and spring. The bots disappear with the old hair and the skin heals over. It is only from July to late fall that hides are of value for leather and clothing. During the remainder of the year they are of little use except for "babiche" (narrow strips or strings) on account of the holes and scars. Their wonderful horn growth begins in the spring and matures in September. The Northern Plains caribou bull is transformed by his horns from a small, rather insignificant animal to one with an imposing presence in repose and of striking appearance in animation.

The heavy storms of early August start the southerly migration of the cows, yearlings, and calves, which travel in bands but with little cohesion, as they may be observed to split up and reform with others when meeting or when disturbed.

The period including late August and September is the easy time of the caribou year cycle; food is abundant; the flies are disappearing, and the weather is not too severe. While the general drift is towards the woods, pauses are made in good feeding grounds, and there is a certain amount of aimless wandering. As the bands move southerly, they meet the bulls in their summer range, and a few old bulls will usually be found with each band, leading the way and mounting guard when resting and feeding. The caribou have remarkable sight, hearing, and scent and are difficult to approach without detection.

The fall gathering at the edge of the woods sees a complete massing of the animals occupying a district. Probably the largest gathering occurs in the district extending from lake MacKay northerly to Great Bear lake. The drift from the Arctic, chiefly cows, yearlings, and calves, passes north of lac de Gras, while another migration, largely of old bulls, passes north and south of Clinton-Colden and Aylmer lakes.

October sees the final massing of the herds, called by the natives the "foules," and the movement into the woods. At this period for days at a time the whole country appears to be covered with moving bands of caribou. From the descriptions given, estimates of their numbers reach well up into the millions. The winter migration has been observed at a number of points, but as there have never been simultaneous observations made at these points, it is largely a matter of speculation as to what relation exists between the various migrations. There appears to be three principal gatherings during the winter which are:

- (1) In the country of the easterly portion of Great Bear lake and that to the south.
- (2) In the country of the east end of Great Slave lake.
- (3) A migration from the country north and east of Dubawnt lake which passes east of lake Athabaska, and through the northerly portion of Cree lake, Foster lake, and Reindeer lake.

It is probable that these three groups are fairly distinct both in their summer and winter range.

The bulls normally lose their horns in December, and the cows in February, but there is considerable variation in this respect. Animals may be observed with horns in every month of the year.

It may be taken as a general rule that the old bulls will be in good condition in summer and fattest about October, while they are very poor in winter. The cows on the other hand are in their best condition in winter.

The moose may be found as far as the edge of the trees. Animals were observed at Taltheilei on Great Slave lake and on Pikes portage route and are numerous in the country bordering the west end of Great Slave lake and eastward from Slave river.

Woodland caribou range the same country as the moose and also may be found as far as the timber line. They are most common in the country north and south of the west end of Great Slave lake.

In general, the game and fur-bearing animals of northern Alberta are to be found throughout the district to the edge of the forests.

In the Arctic area it is at once noted that there is a change in the wild life. The animals whose modes of life are associated with the woodlands disappear and other types take their place. There is also a difference between the representatives of a certain species inhabiting the open plains and his cousins of the bush. This is largely a matter of adaptation, either for protection from his enemies or for assistance in seeking food. It might be said that nature endeavoured to make her wild animals inconspicuous. In the Arctic area this has been done in some cases by giving them a white winter coat and a somewhat mottled effect in summer, both of which match their seasonal background. Examples are the Arctic hare, Arctic fox, and Northern Plains caribou. The musk-ox and wolf, however, do not change, the former remaining dark and a large proportion of the latter white, throughout the year.

The musk-ox may be considered the most distinctive species of the Arctic zone as they do not migrate, and to meet conditions of life in the country they are quite different from other members of the ox family. They are grass eaters and range chiefly in the grassy valleys of the coastal plains. Until recent years they were fairly numerous in the northeastern uplands of Great Slave lake district, and had been seen in small bands along Thelon river. They have been extensively hunted, both from the coast and from Great Slave lake and their numbers greatly reduced, the remaining bands being driven into the most inaccessible portions of their range. Individuals seen in recent years in the vicinity of Clinton-Colden and Aylmer lakes may be considered to be stragglers. The present habitat probably includes the country between Back river and the upper part of Thelon river. The total number of musk-ox living to-day cannot even be guessed at.

Little is known of the Northern Plains grizzly bear and no fresh traces of this species were observed in the district.

The white wolf of the open plains is the chief enemy of the caribou and as such is engaging attention in regard to protective measures to be taken. Wolves may generally be observed in the vicinity of the caribou herd, and there can be little doubt that the annual destruction from this source is considerable; moreover the toll is chiefly among the cows and calves. As the wolves depend chiefly on the caribou for food, they travel with them in their migrations, and it is therefore difficult to estimate their numbers. There can be little question that there are a great many scattered over the country, though they appear to suffer periodically from a form of mange which greatly reduces their numbers.

A recent increased demand for fox skins has given greater value to the Arctic fox and has brought prosperity to the trappers operating in this district. These foxes den far out in the open country and pick up a good summer living on ptarmigans, hare, ground squirrels, and mice. Their bluish, mottled summer coat makes them a most inconspicuous object. They migrate to the woods in winter and obtain their living chiefly from caribou killed by the wolves. In winter the Arctic fox becomes pure white.

The Arctic hare is common throughout the northern plains, inhabiting chiefly the stony hills, where specimens can be seen dodging among the boulders as the southern variety does among the trees. They are a fawn colour in summer and become white in winter, except for the tips of their ears which are black.

Wolverine is found throughout the country but is not common.

Ground squirrels are numerous on the sandy areas and lemming is a common species on the grassy lake margins.

BIRDS

The birds of the woodlands generally range to the limit of the trees, and as these have been studied at many points, they need not be considered here. In the open plains, however, observations have not been so complete. Bird life is not abundant and songsters are almost lacking. The loud ringing cry of the loon, the harsh notes of the gull, raven, and ptarmigan, and the rather plaintive call of the Lapland longspur are almost the only bird notes heard. The most interesting species is the yellow-billed loon. It is strikingly marked in black and white check and reaches a weight of thirteen pounds.

The list of birds observed to be breeding in the Northern Plains follows:—

Geese.—Only one species (white fronted) was noted in this area. Numerous flocks of young were seen on Lockhart river between lake MacKay and Aylmer lake and on the east end of lake MacKay. The young were beginning to fly about August 12.

Ducks.—Old-squaw ducks are common throughout the entire district and were noted breeding in many places. They prefer the small grassy sloughs for breeding but collect in large flocks on the large lakes when the young are able to fly.

Mallard.—A few birds were seen on Lockhart river between lake MacKay and Aylmer lake.

Green-winged Teal.—A number were seen on Lockhart river between lake MacKay and Aylmer lake and on the east end of lake MacKay.

Pintail.—One flock of young was seen on a small pond on the south shore of Clinton-Colden lake.

Red-breasted Merganser.—These ducks are not plentiful but a few were seen on most of the lakes and rivers.

Surf Scoter were not seen past Artillery lake.

Willow Ptarmigan.—These birds are very plentiful and may be found from the sparsely wooded country out upon the northern plains. They were found throughout the entire district covered during the trip.

Rock Ptarmigan.—These were not so plentiful as the willow ptarmigan and were found generally frequenting the high rock country, over the same range.

Common Loon.—Very scarce. They were seen on Artillery and Clinton-Colden lakes.

Red-throated Loon.—Quite common through the entire district. They prefer the small ponds during the summer, where they nest among the reeds.

Pacific Loon.—They were not plentiful at any time but were noted through the whole district.

Yellow-billed Loon.—This is the common loon of the Northern Plains and their loud ringing calls may be heard at any time.



YELLOW-BILLED LOON, LAC DE GRAS

This is the largest and most striking member of the loon family. It is found frequently in Arctic waters but there had formerly been great uncertainty as to the location of its breeding ground. Many were observed with their young around Aylmer lake and lac de Gras. Their loud ringing call is the most conspicuous bird note in the locality.

Lesser Yellow-legs.—One pair seen July 15 on Artillery lake. The young were half grown at this time.

Northern Phalarope.—Very common throughout the whole area, breeding around the small grassy ponds.

Baird's Sandpiper.—Very plentiful over the entire area.

Semipalmated Sandpiper.—Not so plentiful as Baird's sandpiper, but found over the whole area.

Semipalmated Plover.—Rather rare but a few may be found at any point.

Golden Plover.—Quite numerous along Lockhart river between Ptarmigan and Artillery lakes and in the country east of lac de Gras. Breeding wherever seen.

Pectoral Sandpiper.—Not very plentiful. Found breeding on Clinton-Colden lake and in the country east of lac de Gras.

Stilt Sandpiper.—Very plentiful along Lockhart river between Ptarmigan and Artillery lakes and around Clinton-Colden lake.

Arctic Tern.—A few small colonies were noted on all the larger lakes of the district.

California Gull.—Odd pairs were seen throughout the whole area.

Long-tailed Jaeger.—Very plentiful from the north end of Artillery lake, northwards and to the west. They prefer the low swampy country and live mainly on small birds and mice.

Parasitic Jaeger.—They become very plentiful to the north and west of the west end of Aylmer lake. They live almost entirely on longspurs and waders which they take on the wing.

Duck Hawk.—Very rare. Odd pairs may be found at any place.

American Rough-legged Hawk.—One pair noted on Artillery lake but became quite plentiful around lac de Gras.

Marsh Hawk.—A few noted around Artillery lake and lake MacKay.

Sharp-shinned Hawk.—One pair noted near the west end of lake MacKay in the last woods.

Short-eared Owl.—A few birds seen around lake MacKay and to the north near lac de Gras.

Lapland Longspur.—Quite numerous on Artillery lake.

American Pipit.—A few birds may be found at any point but they were nowhere plentiful.

Horned Lark.—A few birds, scattered over the whole area.

Savannah Sparrow.—Fairly common throughout the whole area.

Tree Sparrow.—May be found anywhere in the district and are very abundant wherever any scrub appears.

Common Redpoll.—Distributed like the Tree sparrow but they are more plentiful near the tree line.

Harriss Sparrow.—The breeding range of this sparrow is not definitely known but in the past summer they were found to be very abundant in the country along the edge of the northern plains. They nest on the ground usually under a small bush and the nests are identical with that of the white-crowned sparrow.

FISH

The fish of the northern waters are an asset of importance. Certain species reach their best development there; others are peculiar to these waters; and practically all the lakes and rivers are well stocked.

The white-fish is the outstanding species both in numbers and value. It has been estimated that the yield from the fall fisheries on Great Slave lake exceeds half a million pounds and the largest portion of this is white-fish. Its normal weight is about three pounds but it reaches as high as eight or nine pounds.

Next in importance is the lake trout. There is a considerable range in the colouring of the flesh from yellow to red, and of the scale marking, but it would require expert examination to determine to what extent these differences were due to water conditions and how much to different varieties. There are records of weights as high as fifty pounds, twenty-five pounders are not unusual, while those of ten are very common. The best trout fisheries are near swift water and rapids.



HUNG FISH AT HAY RIVER

Fish are still the chief food supply in winter for man and dog in the Great Slave Lake district. When well dried in the sun they may be kept almost indefinitely. Probably 500,000 pounds of fish are taken annually in Great Slave lake.

A fish of considerable scientific interest is the inconnu (*Stenodus mackenzii*) which is peculiar to Mackenzie river waters, its upstream limit being the rapids at Fort Smith. It has the appearance of a white-fish but is larger, varying from ten to thirty pounds. The inconnu becomes soft in warm water but is of good quality in the early spring.

Back's grayling or the blue-fish is another interesting species. It resembles the white-fish in shape but has an abnormally large back fin. This species is usually found travelling in schools.

Pike, pickerel, and suckers are also found in the sediment-carrying waters of the north arm and west end of Great Slave lake.

Fish are still the chief food supply in winter at the posts and for winter dog feed. The fall fishery is one of the important events of the year. The fish are hung on stages to dry. A spell of unseasonably warm weather in the late fall causes a great amount of damage to the hung fish.

APPENDIX I

GEOLOGICAL NOTES OF PORTIONS OF THE GREAT SLAVE LAKE AREA

By W. L. McDONALD, B.Sc.

Lockhart River Basin.—The district covered by this 1924 survey is underlaid by a series of igneous and metamorphic rocks of Precambrian age. The greater part of the area is covered by glacial deposits and in some cases there are large areas that do not show the bed rock. As a general rule, that part underlaid by the softer metamorphic rock has a low uniform relief and has a better growth of vegetation.

The topographic features vary a great deal throughout the district. The western part is usually very rugged in character with numerous deep glacial valleys. To the east and north the country is more of the open rolling type with long sloping hills. All the low ground is either covered by lakes or swamps. The whole country is plentifully strewn with glacial boulders which are usually angular in shape. There are also numerous boulder and sand moraines, and these always have an east and west trend. The glacial striae on the rocks also indicate a westward movement of the glacier. There are numerous signs which would indicate that many of these lakes were much larger and had a greater elevation at some time. Old beaches occur as much as fifty feet above the present lake level.

Artillery Lake.—At the south end of Artillery lake the country is very rough and shows many signs of strong glacial action. The hills show the characteristic rounded tops; while the valleys have numerous furrows and troughs from ice action. The glacial drift is here very light and is usually in the form of scattered boulders. The underlying rock is granite and gneiss of a dull red to pink colour and of medium grain. In going northwards along the lake the glacial deposits become thicker and the country becomes more gently rolling.

At a point about twenty miles north a new series of rocks appear. These rocks extend across the lake to The Beaver Lodge on the east side and all the islands from here northwards to the inlet of Lockhart river show outcrops of the same rocks. This is a series of dolomite limestones of massive form and varying from a light cream colour to a dark grey. Some of these rocks have been very badly crushed and are cut by numerous veins of calcite. Perfect dolomite crystals are often seen in cavities in the cream coloured rock.

The shores of the lake appear to be the granite and gneiss formation and this extends up Lockhart river to Ptarmigan lake. At the north end of Artillery lake there are many well-defined moraines with an east and west axis which cause swift water or rapids in Lockhart river. One curious feature of this district is the sand ridges which extend for many miles across the country, also with an east and west axis. In some cases the sand is formed into distinct ridges up to 60 or 70 feet in height, with the top horizontal. These are evidently glacial deposits and old lake beaches.

Ptarmigan lake and southern part Clinton-Colden lake.—The country around Ptarmigan lake and the southeast end of Clinton-Colden lake has the same features as along Lockhart river from Ptarmigan to Artillery lake, but has not such well-defined moraines. At Tyrrell point there is an outcrop in the form of a high dome. This is partly covered by glacial drift but the bed rock is

exposed on the south and east sides. The rock is a fine grained grey granite composed of quartz, white feldspar, biotite, and hornblende. This grey granite outcrops at a number of points along the west shore to a point opposite Butte Island. From this point a series of metamorphic rocks are exposed and the country is more open and gently rolling with long uniform slopes leading back from the lake. The prevailing rock of this series is a very soft brown to grey mica schist. It weathers very quickly and in many places areas of sand are seen as the result of weathering.

In this same series, beds of hard black slate and a softer grey slaty shale are found. Frequently, the rocks are badly crushed and distorted, and at such points small stringers and veins of quartz form a network through the rock.

At the narrows, about twelve miles west of Butte island, granite appears on a high point jutting out into the lake. This granite forms a high rugged ridge on the west side of the bay and forms a more or less continuous ridge from there northwestwards to the west end of the lake. This granite is quite different from that formerly observed, being usually red to pink in colour and very coarse grained. At times the ground mass is composed of large grains of quartz and reddish feldspar with a few specks of mica and this whole mass is pitted with large crystals of white feldspar up to two or three inches in length.

The granite crosses to the north side at the east end of the lake and extends westwards to Aylmer lake and possibly eastwards along the north shore of Clinton-Colden lake.

Southern part Aylmer lake.—Aylmer lake is separated from Clinton-Colden lake by a series of moraines and partly by the granite ridge that extends along the south shore of Clinton-Colden lake and northwest to the north shore of Aylmer lake. There is a narrow channel cut through these ridges and at the present time there is a noticeable current at only one point where the channel is partly blocked by a sand and boulder island. The same granite that is found at the west end of Clinton-Colden lake extends along the north shore of Aylmer lake and the numerous points and islands are formed of it.

To the south the country is probably underlaid by schists and slates as there are long gentle slopes back from the water and the few outcrops seen were of mica schist.

A few miles south of the first large bay a high rugged ridge of granite appears and extends westwards. It comes to the water's edge at the foot of the second large bay and then extends westwards about a mile but parallel to the lake until it strikes the lake at the west end and crosses, forming a very high rugged ridge to the north of Lockhart river. This granite is of the same general coarse texture and varies from red to light pink in colour and usually large phenocrysts of white feldspar are scattered throughout the mass.

Upper portion Lockhart river and MacKay lake.—MacKay lake is about 230 feet above Aylmer lake and is drained into Aylmer lake by Lockhart river. This river is a series of lakes with short stretches of swift water between. The whole system is very crooked, caused by the river cutting across a series of parallel boulder moraines. Wherever the bed rock is exposed it is a light grey granite of fine to medium grain. This same formation is seen in the high rugged hills on each side of the first large lake in the system, about 8 miles from Aylmer lake, but from the northwest end of this lake to MacKay lake there are no outstanding features and most of the country is covered with glacial drift.

The country around MacKay lake is usually of the gently rolling type with long uniform slopes back from the shore, the most prominent feature of the east end being a few high granite hills just south of it. At a point about half way down the lake there is a sharp bend westwards and from here the country is very rough. It is very similar to the country at the south end of Artillery lake—high, rugged hills with numerous sharp peaks and very sharp valleys. Granite, usually a dull red to pink in colour and fine grained, is the

prevailing rock, with local areas of gneiss. The country continues to become more rugged to the west and a new series of badly crushed and distorted metamorphic rocks appears near the west end.

The most common is a mica schist of a dark grey to green colour and very hard. Black and brown slates appear with the schist but in small quantities. At one point a very fine-grained quartzite of a pink to green colour is associated with the schist.

Traverse from Lockhart river to lac de Gras.—From Lockhart river to Thonokied lake, about twenty miles slightly west of north, the route followed was through a chain of lakes at the eastern end of a high range of hills. To the east the country is much lower and fairly level with numerous lakes. The high hilly country to the west is underlain by granite but is not of the rugged type. The granite where noted was similar to that found on the upper part of the Lockhart river, usually light grey in colour with a fine to medium grain. The low country to the east is evidently underlain by the soft mica schist. Angular boulders of this schist are thickly strewn over the country and outcrops were noted in a few places.

At the east end of Thonokied lake a series of broken granite hills come in from the west but do not extend past the east end of the lake. This formation continues westward across to lac de Gras and is exposed along the south shore of lac de Gras for some distance. This granite is very similar to that along the south shore of Aylmer lake and is characterized by its light colour and very large crystals of white feldspar. To the north and east the country is more gently rolling and underlain by mica schist. To the north and northwest of this lake there are numerous well defined ridges of sand extending for many miles across the country.

Going westward along the south shore of lac de Gras the granite formation is fairly continuous, with the exception of a few small areas of schist, for about ten or twelve miles. From here to a point near the west end of the lake, mica schist and slate are exposed and the country is low with long, gentle slopes back from the lake. Towards the west end of the lake granite comes in from the north and extends across the lake in a series of high rugged hills. The country around the north bay on lac de Gras is evidently underlain by granite but is covered with such a depth of glacial boulders that very few outcrops were seen. North and east from here the boulders gradually give way to gravel and sand and especially to the east there are some large areas of sand.

From all indications this series of soft metamorphic rocks occupy a depression in the granite country. They have been worn away in part and this basin forms the bed for the series of large lakes found here. Minerals were not noted at any point but time was not available for prospecting.

North shores Clinton-Colden and Aylmer lakes.—From the eastern extremity of the big island, extending along north shore about half way up Clinton-Colden lake a different formation was encountered, consisting of greenstone with numerous veins and stringers of quartz. Along the shore line weathering was most pronounced, leaving a rock surface very similar to rotting ice with the quartz veins in relief. Throughout this area granite outcrops were encountered and also fine green diabase.

On Aylmer lake, north and west shore, with one exception, grey granite alone was noticed. About 6 miles from the entrance to this lake a schist formation breaking into slabs sometimes an inch or two thick was seen. Here it was badly disturbed and broken up. Throughout this whole area glacial action was pronounced, the country to the west end of the lake being more affected than the eastern portion.

On Back river frequent outcrops of grey granite were noted. On the portion of Hanbury river traversed granite was general throughout, in the form of rounded islands and outcrops on side hills. Throughout the trip sand-hills

of striking similarity were noted, all having the top flattened like a pyramid with top cut off. This was especially noticeable southeast of Sifton lake where hills of bare sand were visible for a long way. These sand hills also occurred at intervals along the north shore of Clinton-Colden and Aylmer lakes and could be seen in the distance from the end of the traverse on Back river.

Another peculiarity was the round hills of gravel which serve admirably as land marks. One such hill bordering on Clinton-Colden lake was covered with a black crust of some heavy substance.

The country of the upper Talston river.—The plateau to the south of Great Slave lake is composed entirely of Precambrian rocks. Granite and gneiss predominate, but there are many extensive areas of schistose rocks. The metamorphic rocks noted on Great Slave lake were not observed on the Snowdrift river section, where it makes its descent from the interior plateau, till within a few miles of the lake, where the river breaks through two barriers of reddish shale and sandstone.

Quartz stringers are abundant in many places, sometimes forming close networks through the rock. Considerable local magnetic attraction was observed in the area. The Indians have brought a number of specimens of lead and copper ores, with traces of silver and gold, into Fitzgerald.

APPENDIX II

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In addition to the above, practically all Arctic literature throws light on the conditions obtaining in the north. There are also a number of recent reports by geologists of the Geological Survey of Canada, which are of interest.

